US009253340B2

(12) **United States Patent**
Bednarczyk et al.

(10) **Patent No.: US 9,253,340 B2**
(45) **Date of Patent: Feb. 2, 2016**

(54) **WIRELESS CAMERA WITH IMAGE SHARING PRIORITIZATION**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 374 days.

(21) Appl. No.: **13/294,212**

(22) Filed: **Nov. 11, 2011**

(65) **Prior Publication Data**

US 2013/0120591 A1 May 16, 2013

(51) **Int. Cl.**

H04N 7/00	(2011.01)
H04N 1/00	(2006.01)
H04N 1/21	(2006.01)
H04N 1/333	(2006.01)
H04W 48/18	(2009.01)

(Continued)

(52) **U.S. Cl.**

CPC ***H04N 1/00153*** (2013.01); ***H04L 45/12*** (2013.01); ***H04N 1/00137*** (2013.01); ***H04N 1/00156*** (2013.01); ***H04N 1/00204*** (2013.01); ***H04N 1/00217*** (2013.01); ***H04N 1/00347*** (2013.01); ***H04N 1/00408*** (2013.01); ***H04N 1/2112*** (2013.01); ***H04N 1/33323*** (2013.01); ***H04N 1/33353*** (2013.01); ***H04N 1/33361*** (2013.01); ***H04N 1/33376*** (2013.01); ***H04W 48/18*** (2013.01); *H04N 2101/00* (2013.01); *H04N 2201/006* (2013.01); *H04N 2201/0036* (2013.01); *H04N 2201/0055* (2013.01); *H04N 2201/0084* (2013.01)

(58) **Field of Classification Search**

CPC H04N 1/00204; H04N 1/00214; H04W 48/18; G06F 21/30

USPC 348/14.02, 21, 207.1, 231.3, 231.6; 455/3.06, 435.3, 512, 513; 725/105

See application file for complete search history.

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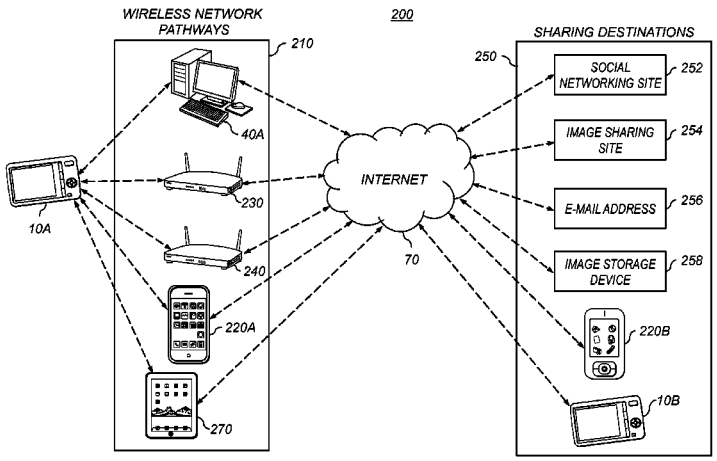
(57) **ABSTRACT**

A digital camera, comprising an image sensor and an optical system for capturing an image of a scene and a wireless communication system. User interface elements are provided enabling a user to select a sharing destination for a captured digital image. A plurality of network pathways are identified for communication with the sharing destination using the wireless communication system. A priority is determined for each of the network pathways and the digital image is transmitted to the sharing destination using the highest priority network pathway.

21 Claims, 8 Drawing Sheets



(51) **Int. Cl.**

H04L 12/721	(2013.01)
H04N 101/00	(2006.01)

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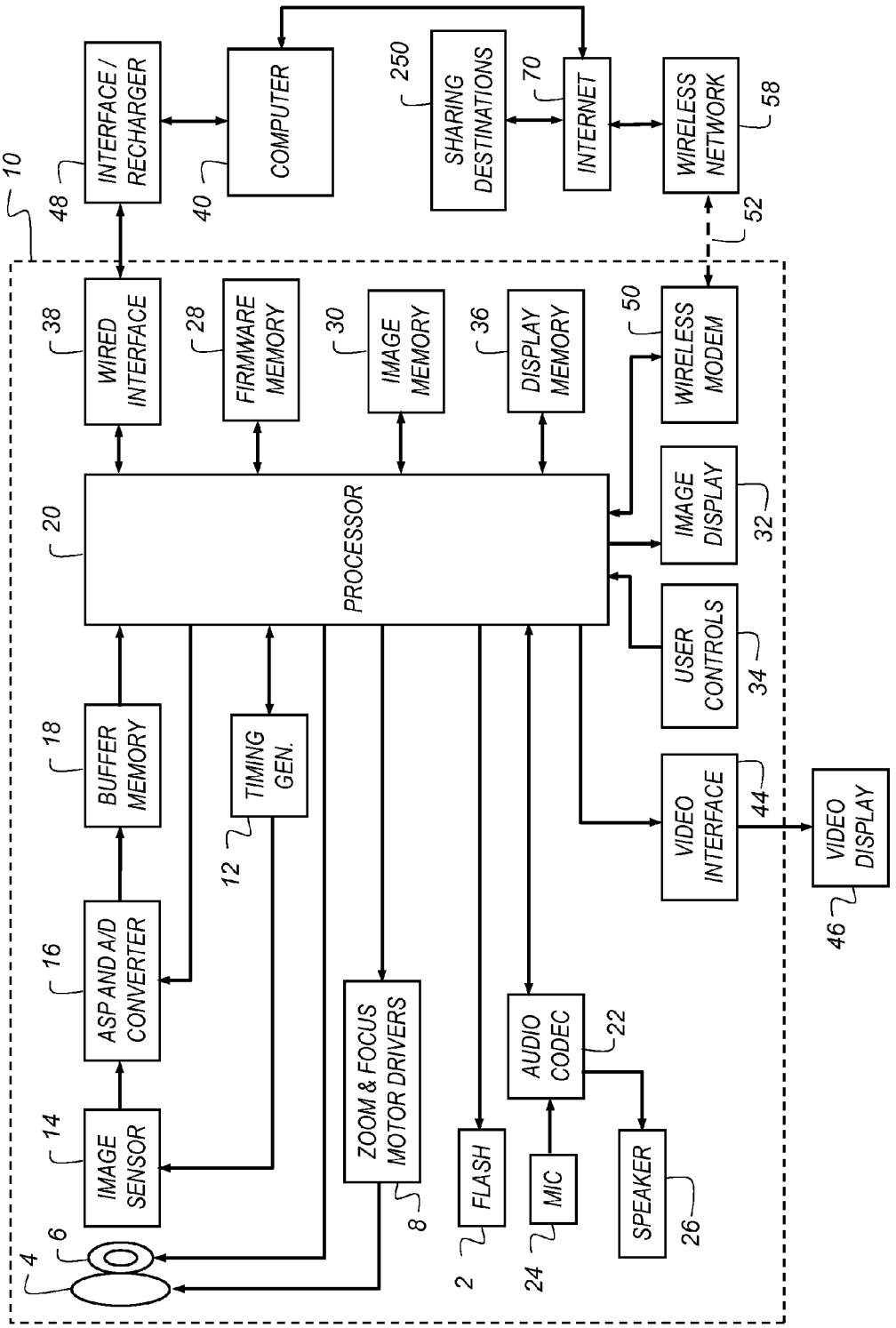
10
INTERFACE / RECHARGER
48
COMPUTER
40
SHARING DESTINATIONS
250
INTERNET
70
WIRELESS NETWORK
58
52
WIRED INTERFACE
38
FIRMWARE MEMORY
28
IMAGE MEMORY
30
DISPLAY MEMORY
36
WIRELESS MODEM
50
PROCESSOR
20
IMAGE DISPLAY
32
USER CONTROLS
34
BUFFER MEMORY
18
TIMING GEN.
12
VIDEO INTERFACE
44
VIDEO DISPLAY
46
ASP AND A/D CONVERTER
16
IMAGE SENSOR
14
ZOOM & FOCUS MOTOR DRIVERS
8
FLASH
2
AUDIO CODEC
22
MIC
24
SPEAKER
26
6
4

FIG. 1

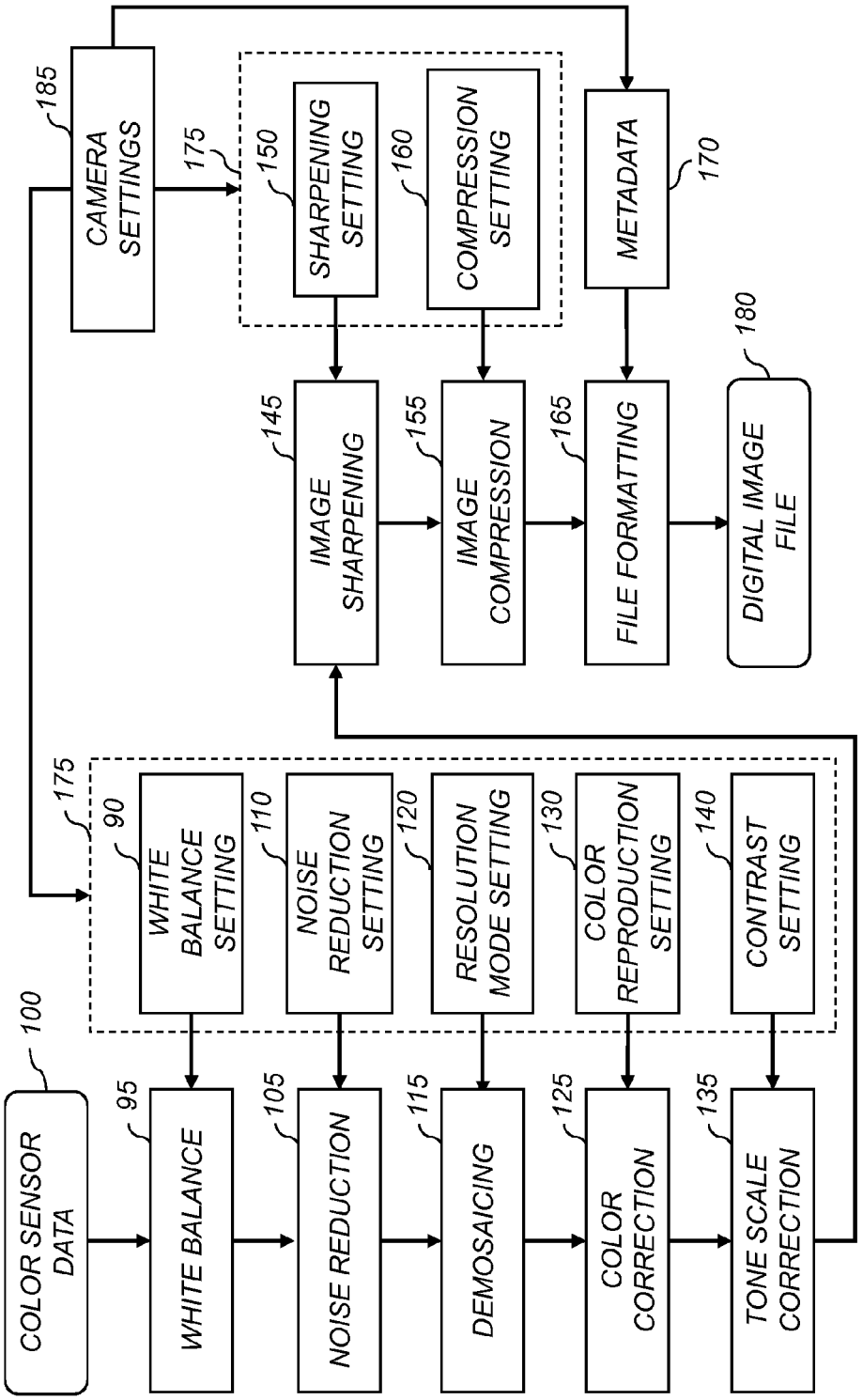
COLOR SENSOR DATA
100
WHITE BALANCE
95
NOISE REDUCTION
105
DEMOSAICING
115
COLOR CORRECTION
125
TONE SCALE CORRECTION
135
175
WHITE BALANCE SETTING
90
NOISE REDUCTION SETTING
110
RESOLUTION MODE SETTING
120
COLOR REPRODUCTION SETTING
130
CONTRAST SETTING
140
IMAGE SHARPENING
145
IMAGE COMPRESSION
155
FILE FORMATTING
165
DIGITAL IMAGE FILE
180
METADATA
170
175
SHARPENING SETTING
150
COMPRESSION SETTING
160
CAMERA SETTINGS
185

FIG. 2

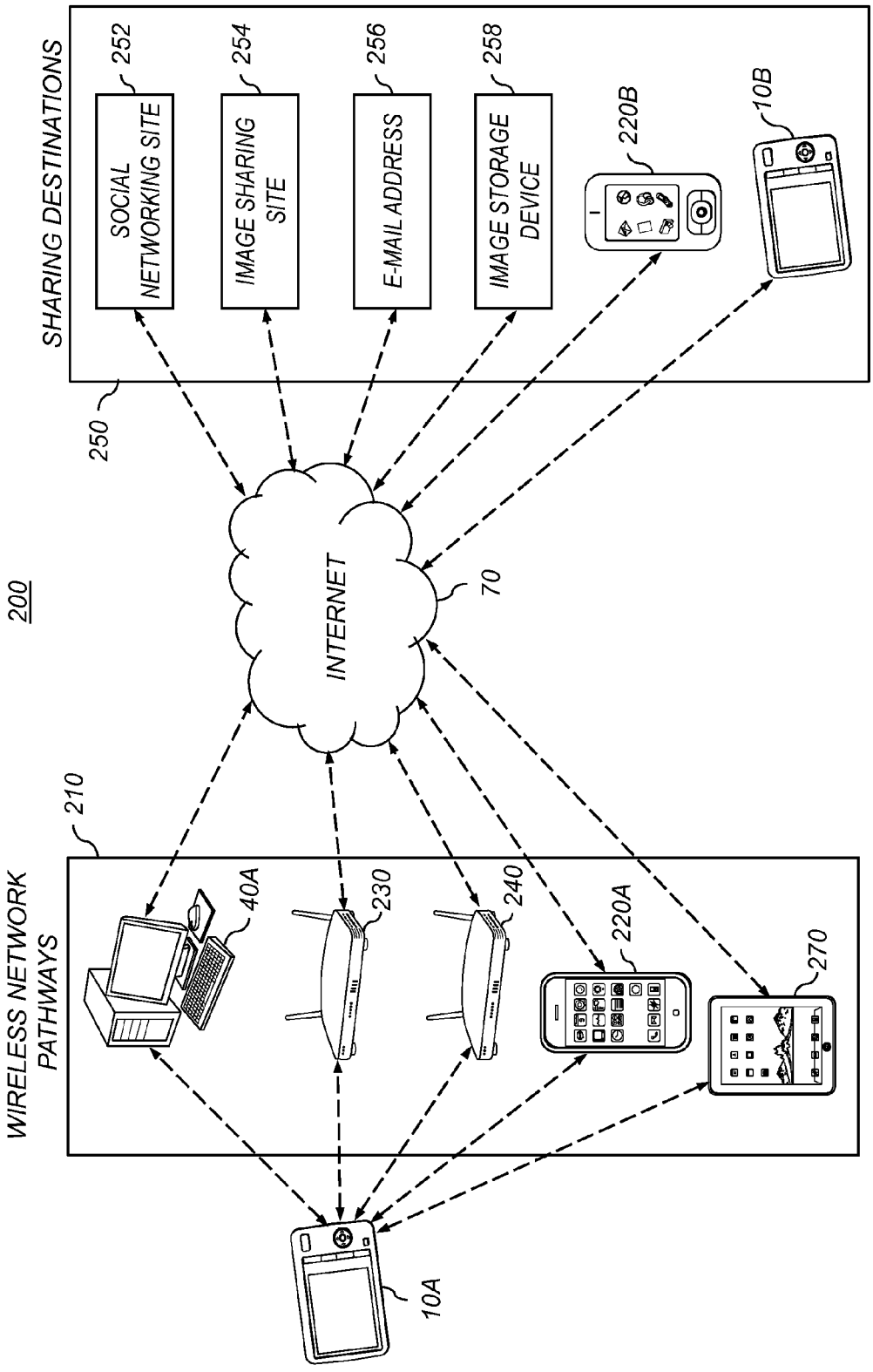
200
SHARING DESTINATIONS
250
252
SOCIAL NETWORKING SITE
254
IMAGE SHARING SITE
256
E-MAIL ADDRESS
258
IMAGE STORAGE DEVICE
220B
10B
INTERNET
70
210
WIRELESS NETWORK PATHWAYS
40A
230
240
220A
270
10A

FIG. 3

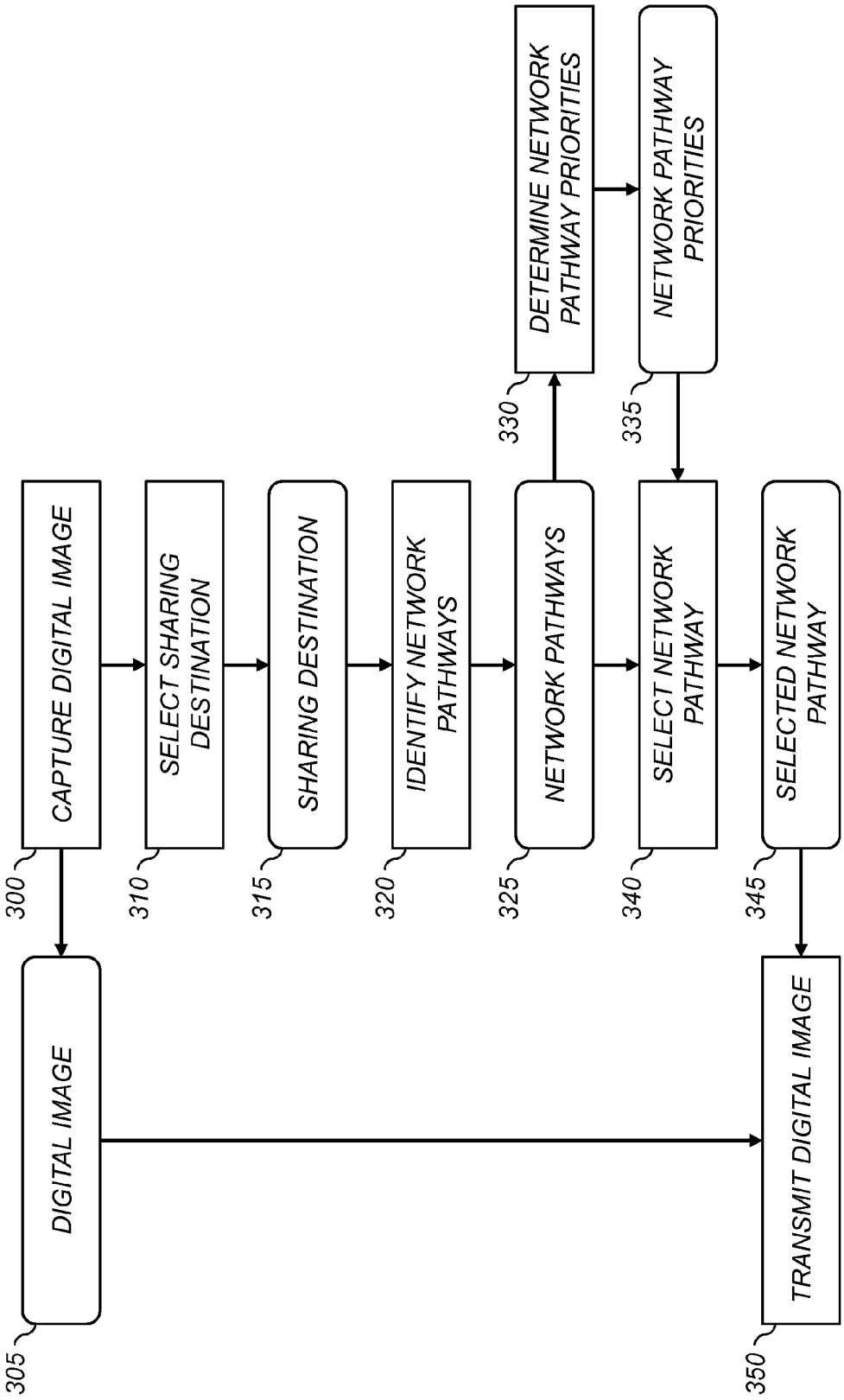
CAPTURE DIGITAL IMAGE
SELECT SHARING DESTINATION
SHARING DESTINATION
IDENTIFY NETWORK PATHWAYS
NETWORK PATHWAYS
SELECT NETWORK PATHWAY
SELECTED NETWORK PATHWAY
DETERMINE NETWORK PATHWAY PRIORITIES
NETWORK PATHWAY PRIORITIES
DIGITAL IMAGE
TRANSMIT DIGITAL IMAGE
300
310
315
320
325
330
335
340
345
305
350

FIG. 4

400

	410	412	414A	414B	416	418
NETWORK PATHWAY	**HOME PC**	**WIRELESS ROUTER**	**HOTSPOT #1**	**HOTSPOT #2**	**SMART PHONE**	**TABLET**
NAME	MY PC	HOME NET	RIT	STAR COFFEE	MY PHONE	MY TABLET
PATHWAY TYPE	WIRELESS PC	WIFI ROUTER	WIFI HOTSPOT	WIFI HOTSPOT	WIFI TO 4GSM	WIFI TO 3GSM
DATA RATE	10Mbps	1Mbps	1Mbps	2Mbps	5Mbps	5Mbps
DATA COST	0	0	0	$2	2GB/MONTH DATA PLAN	200MB/MONTH DATA PLAN
PROCESSING CAPABILITIES	HIGH	NO	NO	NO	MEDIUM	MEDIUM
CAMERA POWER USAGE	LOWEST	HIGH	HIGH	MEDIUM	LOW	LOW
USER PREFERENCE	1	2	3	6	4	5

FIG. 5

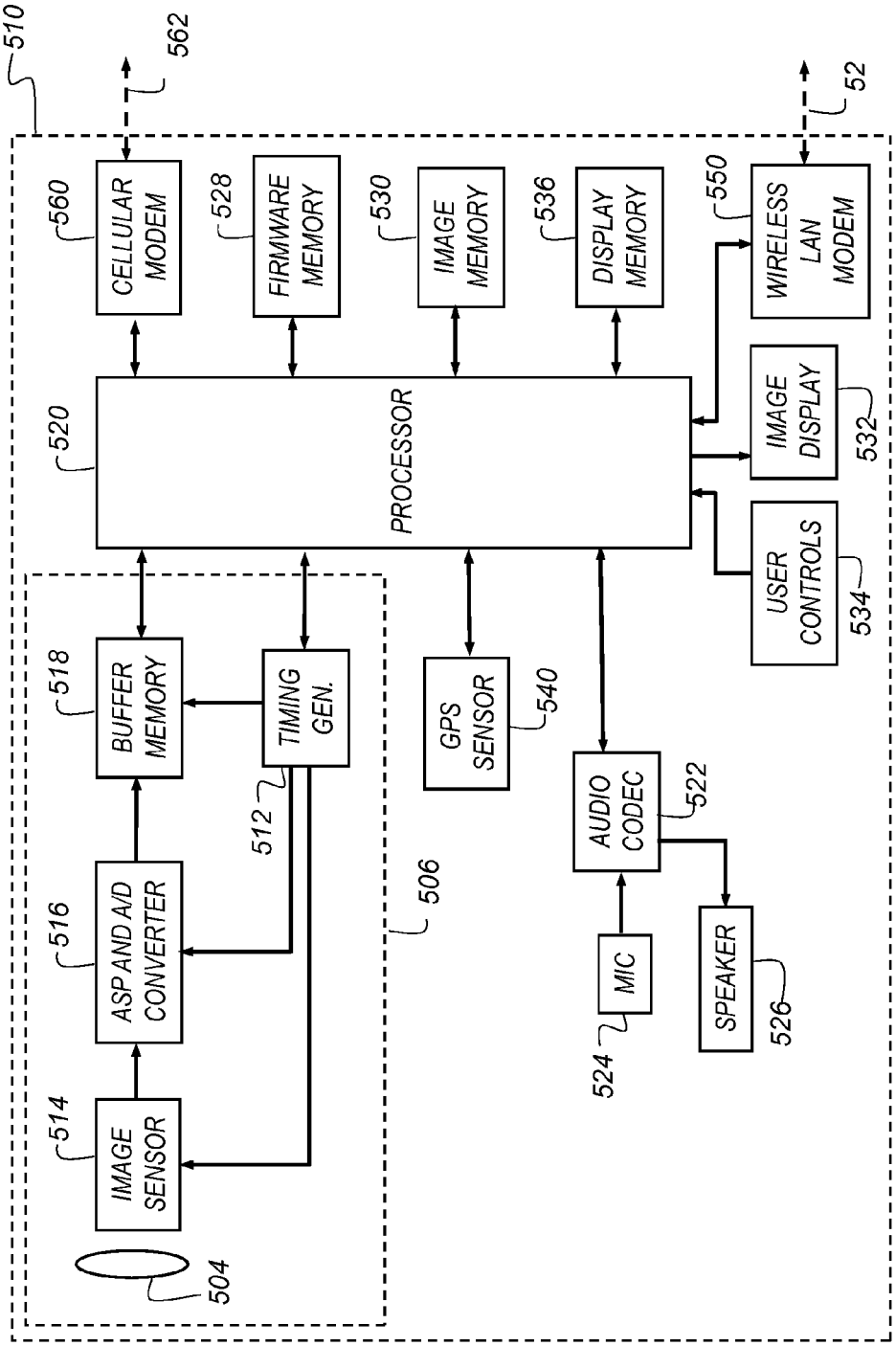
510
562
52
560
CELLULAR MODEM
528
FIRMWARE MEMORY
530
IMAGE MEMORY
536
DISPLAY MEMORY
550
WIRELESS LAN MODEM
520
PROCESSOR
IMAGE DISPLAY
532
USER CONTROLS
534
518
BUFFER MEMORY
TIMING GEN.
512
GPS SENSOR
540
AUDIO CODEC
522
516
ASP AND A/D CONVERTER
506
MIC
524
SPEAKER
526
514
IMAGE SENSOR
504

FIG. 6

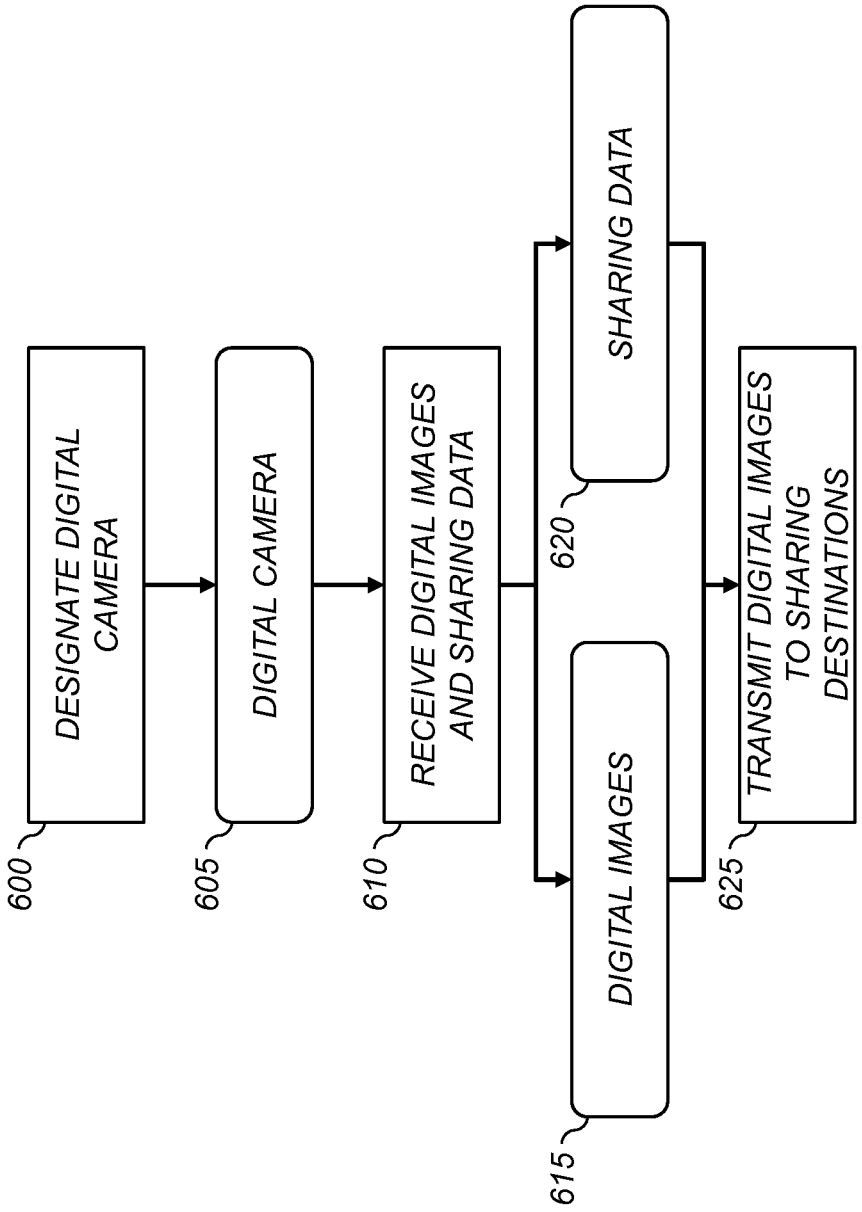
DESIGNATE DIGITAL CAMERA
600
DIGITAL CAMERA
605
RECEIVE DIGITAL IMAGES AND SHARING DATA
610
SHARING DATA
620
DIGITAL IMAGES
615
TRANSMIT DIGITAL IMAGES TO SHARING DESTINATIONS
625

FIG. 7

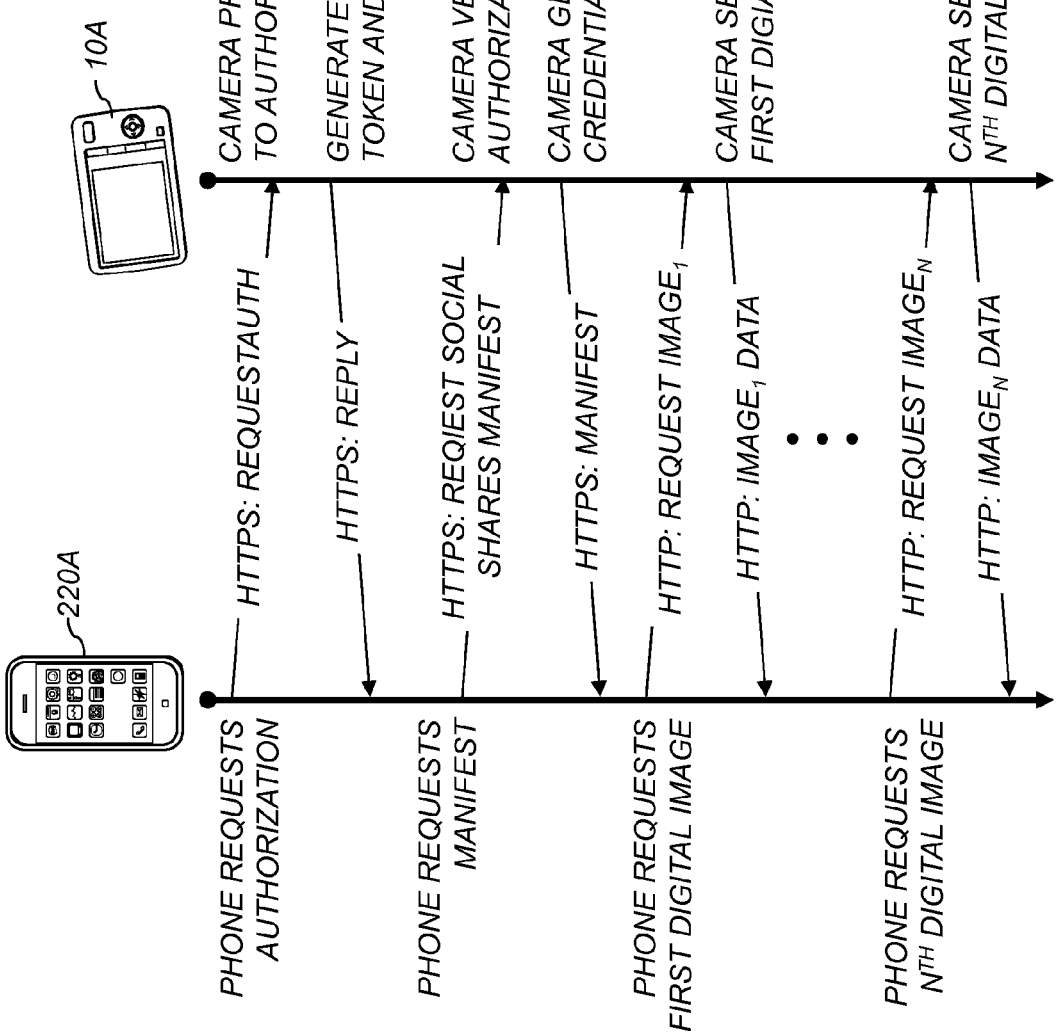
220A
10A
PHONE REQUESTS AUTHORIZATION
HTTPS: REQUESTAUTH
CAMERA PROMPTS USER TO AUTHORIZE CONNECTION
HTTPS: REPLY
GENERATE AUTORIZATION TOKEN AND SEND TO PHONE
PHONE REQUESTS MANIFEST
HTTPS: REQIEST SOCIAL SHARES MANIFEST
CAMERA VERIFIES AUTHORIZATION TOKEN
HTTPS: MANIFEST
CAMERA GENERATES MANIFEST WITH CREDENTIALS AND SENDSTO PHONE
PHONE REQUESTS FIRST DIGITAL IMAGE
HTTP: REQUEST IMAGE1
CAMERA SENDS FIRST DIGIAL IMAGE
HTTP: IMAGE1 DATA
PHONE REQUESTS NTH DIGITAL IMAGE
HTTP: REQUEST IMAGEN
CAMERA SENDS NTH DIGITAL IMAGE
HTTP: IMAGEN DATA

FIG. 8

WIRELESS CAMERA WITH IMAGE SHARING PRIORITIZATION

CROSS-REFERENCE TO RELATED APPLICATIONS

Reference is made to commonly-assigned, co-pending U.S. patent application Ser. No. 13/294,221, entitled "Method for wireless sharing of images", by Bednarczyk et al, incorporated herein by reference.

FIELD OF THE INVENTION

This invention pertains to the field of digital cameras, and more particularly to a digital camera which transfers images over a wireless interface.

BACKGROUND OF THE INVENTION

Digital cameras capture, process, and store digital images. These digital images can be transferred to other devices for viewing, storage and printing. In many cases, digital images are captured and then "shared" over a network, such as the Internet, with family and friends.

Digital cameras can transfer user-selected images over wireless networks, as described in commonly-assigned U.S. Pat. No. 7,936,391 to Ward et al., entitled "Digital camera with communications interface for selectively transmitting images over a cellular phone network and a wireless LAN network to a destination," which is incorporated herein by reference. Ward et al. describe how a user of a digital camera can select one of a plurality of communications icons in order to transfer user-selected digital images from the digital camera to a selected destination over one of a plurality of communications networks. This patent also describes how the user-selected images can be identified using an "image utilization" file, which identifies the digital images to be transferred to the selected destination. In some embodiments, the image utilization file is an "Auto Transfer" file as defined in the well-known DPOF 1.1 standard.

It is known to provide a communication device for interconnecting a digital camera to a communications network, for example as described in U.S. Pat. No. 6,750,902 to Steinberg, et al., entitled "Camera network communication device." This patent describes communications devices that can use various wireless communications technologies, including cellular connections and unlicensed wireless frequencies, to transfer camera data to multiple destinations.

It is known to utilize a wireless digital camera and cellular phone to provide a multi-point wireless link, for example as described in U.S. Pat. No. 7,526,314 to Kennedy, entitled "Remote data storage and retrieval for portable electronics." This patent describes a Bluetooth-enabled camera that communicates to a cellular telephone, which in turn uses a 3G wireless link to remotely store digital images captured by the wireless digital camera on an Internet-connected remote storage device.

It is also known to provide wireless digital cameras that can transfer images to a "smart phone." For example, the Samsung SH100 digital camera sold by Samsung Electronics America includes a WiFi modem which can transfer images to other devices, including smart phones. By loading a custom software application (APP) on the smart phone, the smart phone can be used as a remote shutter release to control the capture of digital images by the digital camera.

It is also known to wirelessly transfer images from a digital camera to a smart phone in order to use the smart phone to share digital images over a cellular data communications network, such as a "3G" network. For example, the company Eye-Fi of Mountain View, Calif. sells a "Mobile X2" SDHC format memory card, which includes a Flash memory to store digital images captured by a digital camera. It also includes a WiFi modem to transfer the digital images over a WiFi network to a computer, a smart phone or a network connection to a sharing web site (such as FaceBook or YouTube).

While it is often desirable to wirelessly share digital images from digital cameras with various sharing destinations, it can be difficult to establish preferred connections from a digital camera to a preferred wireless network when several different wireless networks having different image-transfer related capabilities operate in the same location.

There remains a need to provide improved wireless digital cameras which can easily establish communications with a preferred wireless network, and enable user-selected images to be quickly and easily shared with multiple sharing destinations, no matter where the digital camera is located as images are captured.

SUMMARY OF THE INVENTION

The present invention represents a digital camera, comprising:

an image sensor for capturing a digital image;

an optical system for forming an image of a scene onto the image sensor;

a wireless communication system;

a data processing system;

a storage memory for storing captured images; and

a program memory communicatively connected to the data processing system and storing instructions configured to cause the data processing system to implement a method for sharing digital images across a wireless network, wherein the method includes:

capturing a digital image of the scene using the image sensor;

providing user interface elements enabling a user to select a sharing destination for the digital image;

identifying a plurality of network pathways for communication with the sharing destination using the wireless communication system;

determining a priority for each of the network pathways; and

transmitting the digital image to the sharing destination using the highest priority network pathway.

The present invention has the advantage that when multiple network pathways are available, the network pathway enabling the most efficient data transfer rate can be selected in order to provide an improved user experience, reduce power consumption by the digital camera and reduce any data transmission costs.

It has the additional advantage that the digital camera can automatically share digital images using different network pathways depending on the choices that are available in different environments.

It has the further advantage that the digital camera can efficiently share digital images with a plurality of different sharing destinations by first transmitting them to an intermediate node where they can be distributed to the plurality of sharing destinations.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a high-level diagram showing the components of a digital camera system;

FIG. **2** is a flow diagram depicting image processing operations used to process digital images captured by the digital camera of FIG. **1**;

FIG. **3** is a high-level diagram illustrating a digital imaging system using wireless communication pathways;

FIG. **4** is a flowchart of a method for providing image sharing prioritization in accordance with the present invention;

FIG. **5** is a table showing information useful for determining network pathway priorities;

FIG. **6** is a high-level diagram showing the components of a programmable communications device;

FIG. **7** is a flowchart of a method for using a programmable communication device to transmit digital images from a digital camera to designated sharing destinations; and

FIG. **8** is a diagram illustrating a process for transmitting digital images and sharing data from a digital camera to a programmable communication device in accordance with an embodiment of the present invention.

It is to be understood that the attached drawings are for purposes of illustrating the concepts of the invention and may not be to scale.

DETAILED DESCRIPTION OF THE INVENTION

In the following description, a preferred embodiment of the present invention will be described in terms that would ordinarily be implemented as a software program. Those skilled in the art will readily recognize that the equivalent of such software can also be constructed in hardware. Because image manipulation algorithms and systems are well known, the present description will be directed in particular to algorithms and systems forming part of, or cooperating more directly with, the system and method in accordance with the present invention. Other aspects of such algorithms and systems, and hardware or software for producing and otherwise processing the image signals involved therewith, not specifically shown or described herein, can be selected from such systems, algorithms, components and elements known in the art. Given the system as described according to the invention in the following materials, software not specifically shown, suggested or described herein that is useful for implementation of the invention is conventional and within the ordinary skill in such arts.

Still further, as used herein, a computer program for performing the method of the present invention can be stored in a non-transitory, tangible computer readable storage medium, which can include, for example; magnetic storage media such as a magnetic disk (such as a hard drive or a floppy disk) or magnetic tape; optical storage media such as an optical disc, optical tape, or machine readable bar code; solid state electronic storage devices such as random access memory (RAM), or read only memory (ROM); or any other physical device or medium employed to store a computer program having instructions for controlling one or more computers to practice the method according to the present invention.

The invention is inclusive of combinations of the embodiments described herein. References to "a particular embodiment" and the like refer to features that are present in at least one embodiment of the invention. Separate references to "an embodiment" or "particular embodiments" or the like do not necessarily refer to the same embodiment or embodiments; however, such embodiments are not mutually exclusive, unless so indicated or as are readily apparent to one of skill in the art. The use of singular or plural in referring to the "method" or "methods" and the like is not limiting. It should be noted that, unless otherwise explicitly noted or required by context, the word "or" is used in this disclosure in a non-exclusive sense.

Because digital cameras employing imaging devices and related circuitry for signal capture and processing, and display are well known, the present description will be directed in particular to elements forming part of, or cooperating more directly with, the method and apparatus in accordance with the present invention. Elements not specifically shown or described herein are selected from those known in the art. Certain aspects of the embodiments to be described are provided in software. Given the system as shown and described according to the invention in the following materials, software not specifically shown, described or suggested herein that is useful for implementation of the invention is conventional and within the ordinary skill in such arts.

The following descriptions of digital cameras and digital imaging systems will be familiar to one skilled in the art. It will be obvious that there are many variations of these embodiments that are possible and are selected to reduce the cost, add features or improve the performance of the digital cameras and digital imaging systems.

FIG. **1** depicts a block diagram of a digital camera **10** in accordance with the present invention. Preferably, the digital camera **10** is a portable battery operated device, small enough to be easily handheld by a user when capturing and reviewing images. The digital camera **10** produces digital images that are stored as digital image files using image memory **30**. The phrase "digital image" or "digital image file", as used herein, refers to any digital image file, such as a digital still image or a digital video file.

In some embodiments, the digital camera **10** captures both motion video images and still images. The digital camera **10** can also include other functions, including, but not limited to, the functions of a digital music player (e.g. an MP3 player), a sound or voice recorder, a mobile telephone, a GPS receiver, or a programmable digital assistant (PDA).

The digital camera **10** includes a lens **4** having an adjustable aperture and adjustable shutter **6**. In a preferred embodiment, the lens **4** is a zoom lens and is controlled by zoom and focus motor drivers **8**. The lens **4** focuses light from a scene (not shown) onto an image sensor **14**, for example, a single-chip color CCD or CMOS image sensor. The lens **4** is one type optical system for forming an image of the scene on the image sensor **14**. In other embodiments, the optical system may use a fixed focal length lens with either variable or fixed focus.

The output of the image sensor **14** is converted to digital form by Analog Signal Processor (ASP) and Analog-to-Digital (A/D) converter **16**, and temporarily stored in buffer memory **18**. The image data stored in buffer memory **18** is subsequently manipulated by a processor **20**, using embedded software programs (e.g. firmware) stored in firmware memory **28**. In some embodiments, the software program is permanently stored in firmware memory **28** using a read only memory (ROM). In other embodiments, the firmware memory **28** can be modified by using, for example, Flash EPROM memory. In such embodiments, an external device can update the software programs stored in firmware memory **28** using the wired interface **38** or the wireless modem **50**. In such embodiments, the firmware memory **28** can also be used to store image sensor calibration data, user setting selections and other data which must be preserved when the camera is turned off. In some embodiments, the processor **20** includes a program memory (not shown), and the software programs

stored in the firmware memory **28** are copied into the program memory before being executed by the processor **20**.

It will be understood that the functions of processor **20** can be provided using a single programmable processor or by using multiple programmable processors, including one or more digital signal processor (DSP) devices. Alternatively, the processor **20** can be provided by custom circuitry (e.g., by one or more custom integrated circuits (ICs) designed specifically for use in digital cameras), or by a combination of programmable processor(s) and custom circuits. It will be understood that connectors between the processor **20** from some or all of the various components shown in FIG. **1** can be made using a common data bus. For example, in some embodiments the connection between the processor **20**, the buffer memory **18**, the image memory **30**, and the firmware memory **28** can be made using a common data bus.

The processed images are then stored using the image memory **30**. It is understood that the image memory **30** can be any form of memory known to those skilled in the art including, but not limited to, a removable Flash memory card, internal Flash memory chips, magnetic memory, or optical memory. In some embodiments, the image memory **30** can include both internal Flash memory chips and a standard interface to a removable Flash memory card, such as a Secure Digital (SD) card. Alternatively, a different memory card format can be used, such as a micro SD card, Compact Flash (CF) card, MultiMedia Card (MMC), xD card or Memory Stick.

The image sensor **14** is controlled by a timing generator **12**, which produces various clocking signals to select rows and pixels and synchronizes the operation of the ASP and A/D converter **16**. The image sensor **14** can have, for example, 12.4 megapixels (4088×3040 pixels) in order to provide a still image file of approximately 4000×3000 pixels. To provide a color image, the image sensor is generally overlaid with a color filter array, which provides an image sensor having an array of pixels that include different colored pixels. The different color pixels can be arranged in many different patterns. As one example, the different color pixels can be arranged using the well-known Bayer color filter array, as described in commonly assigned U.S. Pat. No. 3,971,065, "Color imaging array" to Bayer, the disclosure of which is incorporated herein by reference. As a second example, the different color pixels can be arranged as described in commonly assigned U.S. Patent Application Publication 2007/0024931 to Compton and Hamilton, entitled "Image sensor with improved light sensitivity," the disclosure of which is incorporated herein by reference. These examples are not limiting, and many other color patterns may be used.

It will be understood that the image sensor **14**, timing generator **12**, and ASP and A/D converter **16** can be separately fabricated integrated circuits, or they can be fabricated as a single integrated circuit as is commonly done with CMOS image sensors. In some embodiments, this single integrated circuit can perform some of the other functions shown in FIG. **1**, including some of the functions provided by processor **20**.

The image sensor **14** is effective when actuated in a first mode by timing generator **12** for providing a motion sequence of lower resolution sensor image data, which is used when capturing video images and also when previewing a still image to be captured, in order to compose the image. This preview mode sensor image data can be provided as HD resolution image data, for example, with 1280×720 pixels, or as VGA resolution image data, for example, with 640×480 pixels, or using other resolutions which have significantly fewer columns and rows of data, compared to the resolution of the image sensor.

The preview mode sensor image data can be provided by combining values of adjacent pixels having the same color, or by eliminating some of the pixels values, or by combining some color pixels values while eliminating other color pixel values. The preview mode image data can be processed as described in commonly assigned U.S. Pat. No. 6,292,218 to Parulski, et al., entitled "Electronic camera for initiating capture of still images while previewing motion images," which is incorporated herein by reference.

The image sensor **14** is also effective when actuated in a second mode by timing generator **12** for providing high resolution still image data. This final mode sensor image data is provided as high resolution output image data, which for scenes having a high illumination level includes all of the pixels of the image sensor, and can be, for example, a 12 megapixel final image data having 4000×3000 pixels. At lower illumination levels, the final sensor image data can be provided by "binning" some number of like-colored pixels on the image sensor, in order to increase the signal level and thus the "ISO speed" of the sensor.

The zoom and focus motor drivers **8** are controlled by control signals supplied by the processor **20**, to provide the appropriate focal length setting and to focus the scene onto the image sensor **14**. The exposure level of the image sensor **14** is controlled by controlling the f/number and exposure time of the adjustable aperture and adjustable shutter **6**, the exposure period of the image sensor **14** via the timing generator **12**, and the gain (i.e., ISO speed) setting of the ASP and A/D converter **16**. The processor **20** also controls a flash **2** which can illuminate the scene.

The lens **4** of the digital camera **10** can be focused in the first mode by using "through-the-lens" autofocus, as described in commonly-assigned U.S. Pat. No. 5,668,597, entitled "Electronic Camera with Rapid Automatic Focus of an Image upon a Progressive Scan Image Sensor" to Parulski et al., which is incorporated herein by reference. This is accomplished by using the zoom and focus motor drivers **8** to adjust the focus position of the lens **4** to a number of positions ranging between a near focus position to an infinity focus position, while the processor **20** determines the closest focus position which provides a peak sharpness value for a central portion of the image captured by the image sensor **14**. The focus distance which corresponds to the closest focus position can then be utilized for several purposes, such as automatically setting an appropriate scene mode, and can be stored as metadata in the image file, along with other lens and camera settings.

The processor **20** produces menus and low resolution color images that are temporarily stored in display memory **36** and are displayed on the image display **32**. The image display **32** is typically an active matrix color liquid crystal display (LCD), although other types of displays, such as organic light emitting diode (OLED) displays, can be used. A video interface **44** provides a video output signal from the digital camera **10** to a video display **46**, such as a flat panel HDTV display. In preview mode, or video mode, the digital image data from buffer memory **18** is manipulated by processor **20** to form a series of motion preview images that are displayed, typically as color images, on the image display **32**. In review mode, the images displayed on the image display **32** are produced using the image data from the digital image files stored in image memory **30**.

The graphical user interface displayed on the image display **32** is composed of user interface elements which are controlled in response to user input provided by user controls **34**. The user controls **34** are used to select various camera modes, such as video capture mode, still capture mode, and

review mode, and to initiate capture of still images, recording of motion images. The user controls **34** are also used to set user processing preferences, and to choose between various photography modes based on scene type and taking conditions. In some embodiments, various camera settings may be set automatically in response to analysis of preview image data, audio signals, or external signals such as GPS information received from another device.

In some embodiments, the digital camera **10** can include a global position system (GPS) sensor that can be used to provide geographical location information. The geographical location information can be stored as metadata in association with captured digital images. As will be described later in reference to FIG. **7**, in some configurations the GPS sensor can be located in another device, such as a smart phone, that is in communication with the digital camera **10**. In this case, the geographical location information can be communicated from the external device to the digital camera **10** for storage as metadata in association with captured digital images. In other embodiments, geographical location information can be determined based upon the identity of nearby network connection points, such as the MAC address of a nearby Wi-Fi router.

In some embodiments, when the digital camera is in a still photography mode the above-described preview mode is initiated when the user partially depresses a shutter button, which is one of the user controls **34**, and the still image capture mode is initiated when the user fully depresses the shutter button. The user controls **34** are also used to turn on the camera, control the lens **4**, and initiate the picture taking process. User controls **34** typically include some combination of buttons, rocker switches, joysticks, or rotary dials. In some embodiments, some of the user controls **34** are provided by using a touch screen overlay on the image display **32**. In other embodiments, the user controls **34** can include a means to receive input from the user or an external device via a tethered, wireless, voice activated, visual or other interface. In other embodiments, additional status displays or images displays can be used.

The user controls **34** can be used to select captured images to be shared, and to select sharing destinations. The selected images and sharing destinations can be stored in an file, as described in commonly assigned U.S. Pat. No. 7,034,871 to Parulski et al., entitled "Capturing digital images to be transferred to an email address," which is incorporated herein by reference. Alternatively, the sharing destinations may be stored in a searchable database. In some embodiments, the sharing destinations can be provided from a separate device, such as computer **40**, and transferred to the digital camera **10** using the wired interface **38** or the wireless modem **50**. These sharing destinations include entries selected from a Facebook "friends list", for example.

In some embodiments, the selection of images to be shared can be automatically determined based on user direction. For example, a user can indicate that all pictures taken during this capture session are to be automatically shared, where a capture session may be defined as continuing up to the time the user turns off the camera. As an example of when this feature may be useful, a parent of school-age child may be capturing pictures of the child at some school event, and may wish to automatically share all such pictures with an absent parent or relative.

In some embodiments, the selected images and sharing destinations can be identified by maintaining a share database table that contains a row for each share action, where the action is characterized by a share identifier (ShareID), a picture identifier (PictureID) specifying the picture to be shared, and a share destination (DestinationDisplayName, DestinationSortName, DestinationHash). For email shares, the share action can also identify the individual to receive the shared asset (PeopleDisplayName, PeopleSortName, PeopleHash).

In some embodiments, the digital camera **10** includes an orientation sensor (not shown) for sensing an orientation of the digital camera **10**. The orientation information can be used to correct the image orientation, as described in commonly-assigned U.S. Pat. No. 5,900,909 to Parulski et al., entitled "Electronic still camera having automatic orientation sensing and image correction," which is incorporated herein by reference. Orientation sensors are well-known in the art and generally use components such as accelerometers, gyroscopes and electronic compasses to sense an orientation.

An audio codec **22** connected to the processor **20** receives an audio signal from a microphone **24** and provides an audio signal to a speaker **26**. These components can be used to record and playback an audio track, along with a video sequence or still image. If the digital camera **10** is a multifunction device such as a combination camera and mobile phone, the microphone **24** and the speaker **26** can be used for telephone conversation.

In some embodiments, the speaker **26** can be used as part of the user interface, for example to provide various audible signals which indicate that a user control has been depressed, or that a particular mode has been selected. In some embodiments, the microphone **24**, the audio codec **22**, and the processor **20** can be used to provide voice recognition, so that the user can provide a user input to the processor **20** by using voice commands, rather than user controls **34**. The speaker **26** can also be used to inform the user of an incoming phone call. This can be done using a standard ring tone stored in firmware memory **28**, or by using a custom ring-tone downloaded from a wireless network **58** and stored in the image memory **30**. In addition, a vibration device (not shown) can be used to provide a silent (e.g., non audible) notification of an incoming phone call.

According to some embodiments, the processor **20** analyzes the input digital image using a person recognition algorithm to identify at least one particular person in the input digital image. Any type of person recognition algorithm known in the art can be used in accordance with the present invention. Examples of person recognition algorithms include facial recognition algorithms such as those taught in U.S. Pat. No. 6,940,545 to Ray et al., entitled "Face detecting camera and method," U.S. Pat. No. 4,975,969 to Tal, entitled "Method and apparatus for uniquely identifying individuals by particular physical characteristics and security system utilizing the same," and U.S. Pat. No. 7,599,527 to Shah et al., entitled "Digital image search system and method," all of which are incorporated herein by reference. Facial recognition algorithms typically work by determining various facial parameters corresponding to ratios of distances between identifiable points on the human face. The facial parameters determined for a face in a particular digital image can be compared to reference facial parameters determined for a set of predefined persons to determine whether there is a statistically significant match.

In some embodiments, a user may wish to specify to the digital camera that all digital images containing a certain individual should be automatically shared with a particular recipient. For example, the aforementioned parent may be photographing multiple children, and may wish to further specify that all pictures captured of a particular child are automatically shared to the child. Using in-camera face recognition, such embodiments may automatically determine

the recipient. The list of sharing destinations may be expanded to include the information need to associate the face tag with each recipient.

The processor **20** also provides additional processing of the image data from the image sensor **14**, in order to produce rendered sRGB image data which is compressed and stored within a "finished" image file, such as a well-known Exif-JPEG image file, in the image memory **30**.

The digital camera **10** can be connected via the wired interface **38** to an interface/recharger **48**, which is connected to a computer **40**, which can be a desktop computer or portable computer located in a home or office. The computer **40** can transfer digital images via the Internet **70** to sharing destinations **250**. The wired interface **38** can conform to, for example, the well-known USB 2.0 interface specification. Alternatively, the wired interface **38** can conform to other interface specifications, such as the IEEE 1394 "Firewire" interface specification. The interface/recharger **48** can provide power via the wired interface **38** to a set of rechargeable batteries (not shown) in the digital camera **10**.

The digital camera **10** includes a wireless modem **50**, which interfaces over a wireless communication link **52** with the wireless network **58**. The wireless modem **50** can use various wireless interface protocols, such as the well-known 802.11 wireless interface or the well-known Bluetooth wireless interface. Emerging interfaces such as Near Field Communication Interface and Protocol (ISO/IEC 18092 and ISO/IEC 21481) may also be used. The wireless network **58** can connect to the internet **70** using various wireless network pathways.

FIG. **2** is a flow diagram depicting image processing operations that can be performed by the processor **20** in the digital camera **10** (FIG. **1**) in order to process color sensor data **100** from the image sensor **14** output by the ASP and A/D converter **16**. In some embodiments, the processing parameters used by the processor **20** to manipulate the color sensor data **100** for a particular digital image are determined by various photography mode settings **175**, which are typically associated with photography modes that can be selected via the user controls **34**, which enable the user to adjust various camera settings **185** in response to menus displayed on the image display **32**.

The color sensor data **100** which has been digitally converted by the ASP and A/D converter **16** is manipulated by a white balance step **95**. In some embodiments, this processing can be performed using the methods described in commonly-assigned U.S. Pat. No. 7,542,077 to Miki, entitled "White balance adjustment device and color identification device", the disclosure of which is herein incorporated by reference. The white balance can be adjusted in response to a white balance setting **90**, which can be manually set by a user, or which can be automatically set by the camera.

The color image data is then manipulated by a noise reduction step **105** in order to reduce noise from the image sensor **14**. In some embodiments, this processing can be performed using the methods described in commonly-assigned U.S. Pat. No. 6,934,056 to Gindele et al., entitled "Noise cleaning and interpolating sparsely populated color digital image using a variable noise cleaning kernel," the disclosure of which is herein incorporated by reference. The level of noise reduction can be adjusted in response to a noise reduction setting **110**. The noise reduction setting **110** is generally tied to the camera ISO exposure index setting, so that more filtering is performed at higher ISO exposure index settings. The level of noise reduction can be adjusted in response to an ISO setting **110**, so that more filtering is performed at higher ISO exposure index setting.

The color image data is then manipulated by a demosaicing step **115**, in order to provide red, green and blue (RGB) image data values at each pixel location. Algorithms for performing the demosaicing step **115** are commonly known as color filter array (CFA) interpolation algorithms or "deBayering" algorithms. In one embodiment of the present invention, the demosaicing step **115** can use the luminance CFA interpolation method described in commonly-assigned U.S. Pat. No. 5,652,621, entitled "Adaptive color plane interpolation in single sensor color electronic camera," to Adams et al., the disclosure of which is incorporated herein by reference. The demosaicing step **115** can also use the chrominance CFA interpolation method described in commonly-assigned U.S. Pat. No. 4,642,678, entitled "Signal processing method and apparatus for producing interpolated chrominance values in a sampled color image signal", to Cok, the disclosure of which is herein incorporated by reference.

In some embodiments, the user can select between different pixel resolution modes, so that the digital camera can produce a smaller size image file. Multiple pixel resolutions can be provided as described in commonly-assigned U.S. Pat. No. 5,493,335, entitled "Single sensor color camera with user selectable image record size," to Parulski et al., the disclosure of which is herein incorporated by reference. In some embodiments, a resolution mode setting **120** can be selected by the user to be full size (e.g. 3,000×2,000 pixels), medium size (e.g. 1,500×1000 pixels) or small size (750×500 pixels).

The color image data is color corrected in color correction step **125**. In some embodiments, the color correction is provided using a 3×3 linear space color correction matrix, as described in commonly-assigned U.S. Pat. No. 5,189,511, entitled "Method and apparatus for improving the color rendition of hardcopy images from electronic cameras" to Parulski, et al., the disclosure of which is incorporated herein by reference. In some embodiments, different user-selectable color modes can be provided by storing different color matrix coefficients in firmware memory **28** of the digital camera **10**. For example, four different color modes can be provided, so that the color reproduction setting **130** is used to select one of the following color correction matrices:

Setting 1 (Normal Color Reproduction)

$$\begin{bmatrix} R_{out} \\ G_{out} \\ B_{out} \end{bmatrix} = \begin{bmatrix} 1.50 & -0.30 & -0.20 \\ -0.40 & 1.80 & -0.40 \\ -0.20 & -0.20 & 1.40 \end{bmatrix} \begin{bmatrix} R_{in} \\ G_{in} \\ B_{in} \end{bmatrix} \quad (1)$$

Setting 2 (Saturated Color Reproduction)

$$\begin{bmatrix} R_{out} \\ G_{out} \\ B_{out} \end{bmatrix} = \begin{bmatrix} 2.00 & -0.60 & -0.40 \\ -0.80 & 2.60 & -0.80 \\ -0.40 & -0.40 & 1.80 \end{bmatrix} \begin{bmatrix} R_{in} \\ G_{in} \\ B_{in} \end{bmatrix} \quad (2)$$

Setting 3 (De-Saturated Color Reproduction)

$$\begin{bmatrix} R_{out} \\ G_{out} \\ B_{out} \end{bmatrix} = \begin{bmatrix} 1.25 & -0.15 & -0.10 \\ -0.20 & 1.40 & -0.20 \\ -0.10 & -0.10 & 1.20 \end{bmatrix} \begin{bmatrix} R_{in} \\ G_{in} \\ B_{in} \end{bmatrix} \quad (3)$$

Setting 4 (Monochrome)

$$\begin{bmatrix} R_{out} \\ G_{out} \\ B_{out} \end{bmatrix} = \begin{bmatrix} 0.30 & 0.60 & 0.10 \\ 0.30 & 0.60 & 0.10 \\ 0.30 & 0.60 & 0.10 \end{bmatrix} \begin{bmatrix} R_{in} \\ G_{in} \\ B_{in} \end{bmatrix} \quad (4)$$

In other embodiments, a three-dimensional lookup table can be used to perform the color correction step **125**.

The color image data is also manipulated by a tone scale correction step **135**. In some embodiments, the tone scale correction step **135** can be performed using a one-dimensional look-up table as described in U.S. Pat. No. 5,189,511, cited earlier. In some embodiments, a plurality of tone scale correction look-up tables is stored in the firmware memory **28** in the digital camera **10**. These can include look-up tables which provide a "normal" tone scale correction curve, a "high contrast" tone scale correction curve, and a "low contrast" tone scale correction curve. A user selected contrast setting **140** is used by the processor **20** to determine which of the tone scale correction look-up tables to use when performing the tone scale correction step **135**.

The color image data is also manipulated by an image sharpening step **145**. In some embodiments, this can be provided using the methods described in commonly-assigned U.S. Pat. No. 6,192,162 entitled "Edge enhancing colored digital images" to Hamilton, et al., the disclosure of which is incorporated herein by reference. In some embodiments, the user can select between various sharpening settings, including a "normal sharpness" setting, a "high sharpness" setting, and a "low sharpness" setting. In this example, the processor **20** uses one of three different edge boost multiplier values, for example 2.0 for "high sharpness", 1.0 for "normal sharpness", and 0.5 for "low sharpness" levels, responsive to a sharpening setting **150** selected by the user of the digital camera **10**.

The color image data is also manipulated by an image compression step **155**. In some embodiments, the image compression step **155** can be provided using the methods described in commonly-assigned U.S. Pat. No. 4,774,574, entitled "Adaptive block transform image coding method and apparatus" to Daly et al., the disclosure of which is incorporated herein by reference. In some embodiments, the user can select between various compression settings. This can be implemented by storing a plurality of quantization tables, for example, three different tables, in the firmware memory **28** of the digital camera **10**. These tables provide different quality levels and average file sizes for the compressed digital image file **180** to be stored in the image memory **30** of the digital camera **10**. A user selected compression setting **160** is used by the processor **20** to select the particular quantization table to be used for the image compression step **155** for a particular image.

The compressed color image data is stored in a digital image file **180** using a file formatting step **165**. The image file can include various metadata **170**. Metadata **170** is any type of information that relates to the digital image, such as the model of the camera that captured the image, the size of the image, the date and time the image was captured, and various camera settings, such as the lens focal length, the exposure time and f-number of the lens, and whether or not the camera flash fired. In a preferred embodiment, all of this metadata **170** is stored using standardized tags within the well-known Exif-JPEG still image file format. In a preferred embodiment of the present invention, the metadata **170** includes information about various camera settings **185**, including any photography mode settings **175** that were selected by the user. The metadata can also include an indication of the identities of any persons that were identified to be in the captured digital image stored in the stored in the digital image file **180**.

As was discussed earlier with reference to FIG. **1**, in some embodiments the digital camera **10** can receive GPS information from another device, such as a smart phone. In such embodiments, the processor **20** in the digital camera **10** can use the wireless modem **50** to initiate communication with the other device after capturing one or more images in order to request GPS information from the other device. The other device then provides the GPS information, which is stored as metadata in the digital image file **180**.

FIG. **3** is a high-level diagram illustrating a digital imaging system **200**. The digital imaging system **200** includes a digital camera **10**A. The digital imaging system **200** also includes a plurality of wireless network pathways **210** which can be used to transfer digital images captured by the digital camera **10**A to a plurality of sharing destinations **250** over a communications network, such as the Internet **70**. The plurality of wireless network pathways **210** includes a network pathway which uses a wireless-accessible computer **40**A, a network pathway which uses a wireless router **230**, a network pathway which uses a wireless hotspot **240**, a network pathway which uses a wireless link to a smart phone **220**A, and a network pathway which uses a wireless link to a tablet computer **270**. A network pathway which uses near field communication (not shown) can also be used in accordance with the present invention.

In some embodiments, the digital camera **10**A functions as a server, advertising its presence and state to the other components, such as the wireless-accessible computer **40**A and the smart phone **220**A. Application software running on the wireless-accessible computer **40**A and the smart phone **220**A also advertises the presence of these devices, so that they can be discovered on the wireless network.

The wireless-accessible computer **40**A can be, for example, a home computer having a WiFi interface or an Ethernet interface connected to a wireless network, such as an iMac computer sold by Apple Inc., Cupertino, Calif. The wireless-accessible computer **40**A can include a display screen which can display images, a hard drive which can store images, and a cable modem interface to the Internet **70**.

The wireless router **230** can be, for example, a Linksys E3200 High Performance Dual-Band N Router sold by Cisco Corp. of Irvine Calif., which uses the 802.11n "WiFi" standard. The wireless router **230** can provide security using standard security protocols, such as WPA and WPA2, in order to prevent unauthorized devices from using the wireless router **230** to access the Internet **70**.

The wireless hotspot **240** can be, for example, a Cisco WAP4410N Wireless-N Access Point sold by Cisco Corp. of Irvine, Calif. The wireless hotspot **240** can be located in a public location such as a school building, an airport terminal, or a coffee shop. The wireless hotspot **240** can provide security using standard security protocols, such as WPA and WPA2, in order to prevent unauthorized devices from using the wireless hotspot **240** to access the Internet **70**.

The smart phone **220**A can be, for example, an Apple iPhone 4 sold by Apple Inc. of Cupertino, Calif. which uses the iOS operating systems, a Samsung Focus smart phone sold by Samsung Consumer Electronics of Ridgefield Park, N.Y., which uses the Windows Phone 7 operating system, or a Samsung Galaxy S Smart Phone, which uses the Android operating system.

The tablet computer **270** can be, for example, an Apple iPad 2 sold by Apple Inc. of Cupertino, Calif. which uses the iOS operating systems, an HP Slate 500 Tablet PC sold by Hewlett Packard of Palo Alto, Calif., which uses the Windows

7 operating system, or a Samsung Galaxy Tab tablet computer, which uses the Android operating system.

The plurality of sharing destinations **250** can include social networking sites **252**, image sharing sites **254**, E-mail addresses **256**, image storage devices **258**, and other image capture devices such as smart phones **220**B and digital cameras **10**B.

The social networking sites **252** that serve as sharing destinations **250** can include, for example, the Facebook social networking sites. When digital images are shared with a social networking site **252**, they are generally shared with a user account associated with a specified user. The user account may be associated with the user of the digital camera **10**A, or with some other user. The social networking sites can also include other sites such as MySpace (not shown). It will be understood that these social networking sites can be accessed by various individuals to view the shared digital images using, for example, desktop computers, tablet computers, and smart phones.

The image sharing sites **254** can also include online image sharing websites such as the Kodak Gallery image sharing website, or the Yahoo Flickr image sharing website. When digital images are shared with image sharing sites **254**, they are generally shared with a user account associated with a specified user.

The E-mail addresses **256** that serve as sharing destinations **250** can include, for example, E-mail addresses that are provided by Gmail, which is an E-mail service provided by Google, Inc. of Mountain View, Calif. The E-mail addresses **256** can also include E-mail services provided by many other service providers, such as yahoo E-mail and AOL E-mail. It will be understood that digital images sent to E-mail addresses **256** can be accessed by the owners of the E-mail accounts using various means such as desktop computers, tablet computers and smart phones. In some embodiments, an E-mail address **256** can be associated with a digital image display device, such as a KODAK PULSE Digital Frame (W1030S), so that the shared digital images are automatically displayed when they are received by the digital image display device.

The image storage devices **258** that serve as sharing destinations **250** can include a hard disk located in a user's home or office computer. The image storage devices **258** can also include network drives such as the Seagate GoFlex 2 TB Home Network Storage System sold by Seagate Technology of Scotts Valley, Calif., or can be an online storage device such as a cloud server.

The smart phone **220**B and the digital camera **10**B can be devices that are associated with the user of the digital camera **10**A. Alternately, they can be devices associated with other users. For example, the user of the digital camera **10**A can choose to share digital images by sending them to a friend's or relative's smart phone **220**B or digital camera **10**B.

FIG. **4** is a flowchart of a method for sharing digital images according to a prioritization of available wireless network pathways **210** (FIG. **3**). In capture digital image step **300**, a digital image **305** is captured with digital camera **10** (FIG. **10**) and processed as was described earlier in relation to FIG. **1** and FIG. **2**. During the capture digital image step **300**, an optical system, such as lens **4** (FIG. **1**), forms an image of a scene (not shown) onto the image sensor **14** (FIG. **1**). The image sensor **14** is used for capturing images, which are processed by a data processing system, such as processor **20** (FIG. **1**) in the digital camera **10**, and stored in a storage memory, such as image memory **30** (FIG. **1**). The processor **20** is coupled to a program memory, such as firmware memory **28** (FIG. **1**), which stores instructions that control the processing applied to the digital image **305**. A wireless communication system, such as wireless modem **50** (FIG. **1**), is used to share the digital image **305** using wireless network **58** (FIG. **1**).

In select sharing destination step **310**, the processor **20** in the digital camera **10** provides user interface elements including user controls **34** (FIG. **1**) enabling a user to select a sharing destination **315** for the captured digital image **305**. In a preferred embodiment, the sharing destination **315** is selected from a plurality of predefined possible sharing destinations. In some embodiments, a list of the possible sharing destinations is provided on image display **32** (FIG. **1**) of the digital camera **10**, and the user controls **34** enable the user of the digital camera **10** to select a particular sharing destination from the list. The selection can be accomplished using various types of user controls **34**, as was described earlier in relation to FIG. **1**. In some embodiments, the list is provided using text strings, such as "My Facebook page," "My Kodak Gallery account," "My network drive," "Jean's E-mail," "Dad's phone," or "Tom's camera." In other embodiments, the list can be provided using icons or images which represent various devices or persons.

In identify network pathways step **320**, the processor **20** in the digital camera **10** identifies a plurality of available network pathways **325** for communication with the sharing destination **315** using the wireless network **58** (FIG. **1**). (These network pathways **325** can include some or all of the example wireless network pathways **210** shown in FIG. **3**.) It will be understood that various well-known communications protocols can be used by the digital camera **10**. For example, the digital camera **10** can use the IPv4 protocol for communication with system components and can use the DNS-SD and mDNS protocols to carry out service discovery.

For example, if the digital camera **10** is being used in the user's home, the available network pathways **325** can include a network pathway **325** that uses a wireless-accessible computer **40**A (FIG. **3**), a network pathway **325** that uses a wireless router **230** (FIG. **3**), and a network pathway **325** that uses a wireless link to the user's smart phone **220**A (FIG. **3**), assuming that all of these devices are turned on, and are located at positions which are near enough to the digital camera **10** to allow sufficient signal strength for wireless communications.

In another example, if the digital camera **10** is being used outside the user's home, for example at a college campus, the available network pathways **325** can include a network pathway **325** that uses a wireless hotspot **240** (FIG. **3**) and a network pathway **325** that uses the user's smart phone **220**A (FIG. **3**). If the digital camera **10** is being used in a remote area, such as a park or beach, the available network pathways **325** might include only the network pathway **325** that uses the user's smart phone **220**A.

In some cases, it is possible that no available network pathways **325** can be identified. For example, the digital camera **10** may be being used in a wilderness location where the user's smart phone **220**A is too far away from a cellular telephone tower to enable the smart phone **220**A to establish communications with the Internet **70**, or if the smart phone **220**A is not powered on. In this scenario, the digital image **305** will be shared at a later time when a network pathway **325** becomes available, where the later time can be determined by monitoring the availability of network pathways **325** or can be a pre-determined check time, or any combination thereof.

In a determine network pathway priorities step **330**, the processor **20** in the digital camera **10** determines a network pathway priority **335** for each of the network pathways **325**. In various embodiments, the network pathway priorities **335**

can be determined responsive to various factors associated with the network pathways **325**. For example, network pathway priorities **335** can be determined responsive to factors such as estimated data transfer rates for the identified network pathways **325**, estimated transmission times for transmitting the digital image **305** over the different identified network pathways **325**, estimated power consumption that will be used by the digital camera **10** to transmit the digital image **305** over the identified network pathways **325**, or estimated costs to transmit the digital image **305** over the identified network pathways **325**, or combinations thereof.

It will be understood that the available network pathways **325** identified in the identify network pathways step **320** can provide different data transfer rates, and will therefore provide different total transmission times. In some embodiments, the determine network pathway priorities step **330** determines the network pathway priorities **335** responsive to the respective data transfer rates (or estimated transmission times). Network pathways **325** having higher data transfer rates (or faster total transmission times) can be assigned a higher network pathway priority **335** than network pathways **325** having lower data transfer rates (or slower total transmission times). Assigning the network pathway priorities **335** in this manner enables the network pathway **325** to be selected that will minimize the time required to transmit the digital image **305** to the sharing destination.

In some cases, one or more of the network pathways **325** may involve multiple transmission steps (e.g., from the digital camera **10** to the smart phone **220**A to the Internet **70** to the selected sharing destination **315**). Each of these transfer steps will have an associated data transfer rate. In some embodiments, the digital camera **10** may be incapable of performing other functions such as capture while data is being transferred. The data transfer rate associated with transferring the digital image **305** off of the digital camera **10** can be used to determine the associated network pathway priority **335** since this is the data transfer rate that will determine how quickly the user will be able to use the digital camera **10** to perform other functions, such as capturing additional digital images. For example, wirelessly transferring data to a wireless-accessible computer **40**A is, in most cases, faster than transferring data directly to the Internet **70** through a wireless router **230** via an Internet Service Provider. In other embodiments, the data transfer rate associated with the rate limiting step can be used to determine the associated network pathway priority **335**, which will provide an indication of the overall data transfer rate. For example, when transferring data from the digital camera **10**A to a smart phone **220**A will typically be faster than transferring the data from the smart phone **220**A to the Internet via 4G.

Consider the case where the network pathway priorities **335** are determined from the data transfer rates (or the estimated total transfer times). The data transfer rates can be pre-determined fixed values associated with the network pathways or can be calculated during wireless transmission by the digital camera **10**A over the network pathways, or alternatively can be received by the digital camera **10**A from the wireless enabled computer **40**A or Smartphone **220**A as part of wireless communication sharing data. The network pathway priorities **335** can be determined using a variety of different methods. For example, in some embodiments, the network pathway priorities **335** can be numerical values representing the data transfer rate (or the estimated transmission time) for each network pathway **325**. In other embodiments, the network pathway priorities **335** can be ordinal values determined by sorting the available network pathways **325** according to their data transfer rates and assigning a "1" to the network pathway **325** with the highest data transfer rate, a "2" to the network pathway **325** with the second highest data transfer rate, and so forth.

For example, consider an example where the digital camera **10** is operating in a home WiFi environment that includes a wireless-accessible computer **40**A and a wireless router **230**. The set of network pathways **325** available to share the digital image **305** with a social networking site **252** sharing destination include a first network pathway **325** that involves transferring the digital image **305** from the digital camera **10** to the wireless-accessible computer **40**A, and from there to the social networking site **252** via the internet, and a second network pathway **325** that involves transferring the digital image **305** from the digital camera **10** through the wireless router **230** to the social networking site **252** via the internet. The determine network pathway priorities step **330** can prioritize these network pathways **325** in order to select the one that will maximize the data transfer rate for transferring the digital image **305** off the digital camera (or equivalently will minimize the time required to transfer the digital image **305** off the digital camera **10**). In this case, the first network pathway **325** would generally be assigned the higher priority since the expected WiFi data transfer rate between the digital camera **10** and the wireless-accessible computer **40**A will generally be an order of magnitude faster than the data transfer rate associated with directly uploading the digital image **305** to the Internet through the wireless router **230** given the upload speeds typically experienced in the typical consumer home environment.

It will be understood that reducing the data transmission time reduces the power drain on the camera's battery, and improves the overall user experience. Using an intermediate node on the network pathway, such as the wireless-accessible computer **40**A or the smart phone **220**A, can further improve camera battery usage in the case where the captured digital image **305** is intended for multiple sharing destinations **250**. If the digital camera **10** is responsible for sending the captured digital image **305** directly to multiple sharing destinations **250** using the wireless router **230** or the wireless hotspot **240**, then sharing the captured digital image **305** with multiple sharing destinations **250** requires the digital camera **10** to transmit the captured digital image **305** multiple times, once for each sharing destination **315**. By using the wireless-accessible computer **40**A or the smart phone **220**A as an intermediate node on the network pathway, the digital camera **10** need only transmit the captured digital image **305** once, along with the list of intended destinations. The intermediate node can then transmit the captured digital image **305** to the plurality of sharing destinations **315**. In addition, the digital image **305** can be stored on the intermediate node, in order to allow it to be viewed on the wireless-accessible computer **40**A or the smart phone **220**A at a later time, or to be printed or archived.

It will be understood that the smart phone **220**A uses an application, which will be described later in reference to FIG. **8**, in order to transfer the digital image **305** to any sharing destination to which the smart phone **220**A can establish a cellular data connection.

In some embodiments, the network pathway priorities **335** are determined responsive to a plurality of factors and user-specified constraints and preferences. For example, the user-specified preferences can include a user-specified preference order specifying a priority order for the plurality of network pathways **325**. FIG. **5** shows a network pathway table **400** listing information that can be used by the determine network pathway priorities step **330** (FIG. **4**) in some embodiments of the present invention. The columns of the network pathway

table **400** provide information for a plurality of network pathways **325** (FIG. **4**), including a home PC network pathway **410** through a wireless-accessible computer **40**A (FIG. **3**) named "MY PC," a wireless router network pathway **412** through a wireless router **230** (FIG. **3**) named "HOME NET," a hotspot #1 network pathway **414**A through a first wireless hotspot **240** (FIG. **3**) named "RIT," a hotspot #2 network pathway **414**B through a second wireless hotspot **240** named "STAR COFFEE," a smart phone network pathway **416** through a smart phone **220**A (FIG. **3**) named "MY PHONE," and a tablet network pathway **418** through a tablet computer **270** (FIG. **3**) named "MY TABLET."

The network pathway table **400** shown in FIG. **5** includes rows which give the pathway type, data rate, data cost, processing (or storage) capabilities, camera power usage, and user preference for each of the network pathways.

In some embodiments, the data rate row of the network pathway table **400** in FIG. **5** is used to determine the network pathway priorities **335** for the plurality of network pathways **325** in determine network pathway priorities step **330** of FIG. **4**. For example, whenever the home PC is one of the network pathways identified in identify network pathways step **320**, then it will be determined to have the highest network pathway priority **335**, since it has the highest data rate (e.g., 10 Mbits/sec) of all of the network pathways listed in FIG. **5**. As another example, if the identify network pathways step **320** identifies the hotspot #1 network pathway **414**A and the smart phone network pathway **416** as the two possible network pathways **325**, then the smart phone network pathway **416** will be determined to be the highest priority because it provides a data rate of 5 Mbits/sec, which is greater than the 1 Mbit/sec data rate provided by the hotspot #1 network pathway **414**A. In both of these examples, determine network pathway priorities step **330** determines the network pathway priorities **335** responsive to the estimated data transfer rates of the identified network pathways **325**. (It will be understood that the total transmission times of the identified network pathways is a mathematical function of the data rate, the size of the digital images to be transferred using the network pathways **325**, and the signal environment. Therefore, in some embodiments, the determine network pathway priorities step **330** can use the transmission time, rather than the data transfer rate, to determine the network pathway priorities **335**.)

In some embodiments, the data cost row of the network pathway table **400** in FIG. **5** is used to determine the network pathway priorities **335** for the plurality of network pathways **325** in determine network pathway priorities step **330** of FIG. **4**. In some cases, the data cost may be specified in terms of a fixed cost for accessing the network pathway **325**. In other cases, the data cost may be specified in terms of a cost/MB, or may be specified in terms of a constraint on the number of MB/month that can be transferred without incurring extra costs. For example, if the identify network pathways step **320** identifies the hotspot #1 network pathway **414**A and the smart phone network pathway **416** as the two possible network pathways **325**, then the hotspot #1 network pathway **414**A will be determined to be the highest priority because it corresponds to a lower data transmission cost (i.e., "0" indicating that there is no cost) compared to the data cost associated with the 2 GByte/month data plan associated with the smart phone network pathway **416**. In this example, determine network pathway priorities step **330** determines the network pathway priorities **335** responsive to the estimated data transmission costs associated with the identified network pathways **325**.

In some embodiments, the processing capabilities row of the network pathway table **400** in FIG. **5** is used to determine the network pathway priorities **335** for the plurality of network pathways **325** in determine network pathway priorities step **330** of FIG. **4**. For example, whenever the home PC network pathway **410** is one of the network pathways **325** identified in the identify network pathways step **320**, then it will be determined to have the highest priority since it has the highest processing capability of all of the network pathways **325** listed in FIG. **5**. As another example, if the identify network pathways step **320** identifies the hotspot #1 network pathway **414**A and the smart phone network pathway **416** as the two possible network pathways **325**, then the smart phone network pathway **416** will be determined to be the highest priority because it provides a "MEDIUM" processing capability, which is greater than the "NO" processing capability provided by the hotspot #1 network pathway **414**A. In both of these examples, determine network pathway priorities step **330** determines the network pathway priorities **335** responsive to the processing capabilities associated with intermediate nodes on the identified network pathways **325**. In some embodiments, a storage capability associated with the network pathways **325** can be used instead of, or in addition to the processing capabilities.

In some embodiments, the power usage row of the network pathway table **400** in FIG. **5** is used to determine the network pathway priorities **335** for the plurality of network pathways **325** in determine network pathway priorities step **330** of FIG. **4**. In this example, the power usage is specified using a power usage category (e.g., "LOWEST," "LOW," "MEDIUM" or "HIGH"). In other cases, the power usage may be specified using a quantitative value, in terms of units such as power consumption/MB. Whenever the home PC network pathway **410** is one of the network pathways **325** identified in identify network pathways step **320**, then it will be determined to have the highest priority since it has the lowest power usage of all of the network pathways **325** listed in FIG. **5**. As another example, if the identify network pathways step **320** identifies the hotspot #1 network pathway **414**A and the smart phone network pathway **416** as the two possible network pathways **325**, then the smart phone network pathway **416** will be determined to be the highest priority because it provides a "LOW" camera power usage, which is less than the "HIGH" camera power usage provided by the hotspot #1 network pathway **414**A. In both of these examples, determine network pathway priorities step **330** determines the network pathway priorities **335** responsive to the estimated power usage associated with the identified network pathways **325**.

In some embodiments, the user preference row of the network pathway table **400** in FIG. **5** is used to determine the network pathway priorities **335** for the plurality of network pathways **325** in determine network pathway priorities step **330** of FIG. **4**. The user preference row stores a user-assigned priority value for each of the network pathways **325**. For example, whenever the home PC network pathway **410** is one of the network pathways **325** identified in identify network pathways step **320**, then it will be determined to have the highest priority, since it has a user preference value of 1, which indicates that it has the highest priority of all of the network pathways **325** listed in FIG. **5**. As another example, if the identify network pathways step **320** identifies the hotspot #1 network pathway **414**A and the smart phone network pathway **416** as the two possible network pathways **325**, then the hotspot #1 network pathway **414**A will be determined to be the highest priority because it corresponds to a more preferred user preference value (i.e., "3") compared to the user preference value for the smart phone network pathway **416** (i.e., "4"). In both of these examples, determine network pathway priorities step **330** determines the network

pathway priorities **335** responsive to user specified preferences associated with the identified network pathways **325**.

In some embodiments, the network pathway priorities **335** may be determined by combining data from a plurality of rows in the network pathway table **400**. In some cases, the values from the different rows can be combined, for example by performing a weighted average. In other cases, the values from one row can be used as the primary factor to determine the network pathway priorities **335**, and additional rows can be used for tie breaking purposes. For example, the data cost can be used as the primary factor and the data rate can be used as a secondary factor to break ties when multiple network pathways **325** have the same data cost. In some embodiments, user controls can be provided to enable the user to specify which factors should be used as the primary and secondary factors.

Returning to a discussion of FIG. **4**, a select network pathway step **340** is used to identify a selected network pathway **345** responsive to the network pathway priorities **335** associated with the network pathways **325**. Generally, the select network pathway step **340** will select the network pathway **325** having the most favorable network pathway priority **335**. In some embodiments, the select network pathway step **340** may impose one or more constraints that would cause it to select a network pathway **325** that does not have the most favorable network pathway priority **335**. For example, in some embodiments, the network pathway priorities **335** are determined based on the data rate associated with the network pathways **325**. The select network pathway step **340** would then select the network pathway **325** that delivers the highest associated data rate. However, the select network pathway step **340** can impose a constraint that a network pathway **325** should only be selected if the monthly data usage limits for the associated data plan have not been exceeded.

In some embodiments, the user may control the timing of sharing with certain sharing destinations based upon the available network path priority, or some other metric. For example, a user may wish to share one or more images immediately with a spouse or other significant person regardless of the cost or available route. However, the user may be willing to defer sharing with other sharing destinations until more favorable network pathway may be found.

In transmit digital image step **350**, the processor **20** in the digital camera **10** transmits the digital image **305** to the sharing destination using the selected network pathway **345** which was determined in the select network pathway step **340**. In a preferred embodiment, the digital image **305** is transmitted by transmitting the digital image file **180** (FIG. **2**), which includes metadata relating to the captured digital image **305**, such as GPS metadata provided by a smart phone as described earlier in relation to FIG. **1**.

In some embodiments, a plurality of sharing destinations **315** can be selected by the user of the digital camera **10** during the select sharing destination step **310**. In this case, the determine network pathway priorities step **330** can determine the network pathway priorities **335** taking into account the fact that some network pathways **325** may support the transmission of the digital image **305** to an intermediate node on the network pathway, such as wireless-accessible computer **40**A, from which it can then be transmitted to the plurality of sharing destinations. Selecting one of these network pathways **325** enables the digital image **305** to be transmitted once to the intermediate node, and the intermediate node will then transmit the digital image **305** to the plurality of sharing destinations **250**. In some embodiments, the digital image **305** is also archived on the intermediate node for archival purposes or future viewing by the user.

As was described earlier in reference to the identify network pathways step **320**, it is possible that no available network pathways **325** are identified at the time the sharing destination **315** is selected. In some embodiments, the transmission of the digital image **305** is delayed until at least one network pathway **325** is identified at a later time, and the captured digital image **305** is then transmitted to the sharing destination **315** at this later time. In other embodiments, an error message is displayed and the transmission of the digital image **305** is cancelled.

FIG. **6** is a high-level diagram showing the components of a programmable communications device **510**. The programmable communications device **510** can be, for example, a smart phone device or tablet device, such as the smart phone **220**A or the tablet computer **270** described earlier in reference to FIG. **3**. Preferably, the programmable communications device **510** is a portable battery operated device, small enough to be easily handheld by a user.

In some embodiments, the programmable communications device **510** includes a digital camera module **506** which captures both motion video images and still images. The programmable communications device **510** can also include other functions, including, but not limited to, the functions of a digital music player (e.g. an MP3 player), a mobile telephone, a GPS receiver, or a programmable digital assistant (PDA).

The digital camera module **506** includes a lens **504** which focuses an image of a scene (not shown) onto an image sensor **514**. The output of the image sensor **514** is converted to digital form by Analog Signal Processor (ASP) and Analog-to-Digital (A/D) converter **516**, and temporarily stored in buffer memory **518**. The image data stored in buffer memory **518** is subsequently manipulated by a processor **520**, using embedded software programs (e.g., firmware stored in firmware memory **528**). Processed images are stored in image memory **530**.

The processor **520** in the programmable communications device **510** can perform many other functions, in response to instructions stored in firmware memory **528**. It will be understood that the functions of processor **520** can be provided using a single programmable processor or by using multiple programmable processors, including one or more digital signal processor (DSP) devices. Alternatively, the processor **520** can be provided by custom circuitry (e.g., by one or more custom integrated circuits (ICs) designed specifically for use in digital cameras), or by a combination of programmable processor(s) and custom circuits. It will be understood that connectors between the processor **520** from some or all of the various components shown in FIG. **6** can be made using a common data bus. For example, in some embodiments the connection between the processor **520**, the buffer memory **518**, the image memory **530**, and the firmware memory **528** can be made using a common data bus.

The processor **520** produces menus and low resolution color images that are temporarily stored in display memory **536** and are displayed on the image display **532**. The graphical user interface displayed on the image display **532** is composed of user interface elements which are controlled in response to user input provided by user controls **534**. The user controls **534** are used to select various functions and programs, such as APPS, which can be stored in the firmware memory **528**.

The user controls **534** are also used to turn on the programmable communications device **510** and select various modes and settings. User controls **534** typically include some combination of buttons, rocker switches, joysticks, or rotary dials. In some embodiments, some of the user controls **534** are

provided by using a touch screen overlay on the image display **532**. In other embodiments, the user controls **534** can include a means to receive input from the user or an external device via a tethered, wireless, voice activated, visual or other interface. In other embodiments, additional status displays or images displays can be used.

An audio codec **522** connected to the processor **520** receives an audio signal from a microphone **524** and provides an audio signal to a speaker **526**. These components can be used for telephone conversations, as well as to record and playback an audio track, along with a video sequence or still image.

In some embodiments, the speaker **526** can be used as part of the user interface, for example to provide various audible signals which indicate that a user control has been depressed, or that a particular mode has been selected. In some embodiments, the microphone **524**, the audio codec **522**, and the processor **520** can be used to provide voice recognition, so that the user can provide a user input to the processor **520** by using voice commands, rather than user controls **534**. The speaker **526** can also be used to inform the user of an incoming phone call. In addition, a vibration device (not shown) can be used to provide a silent (e.g., non audible) notification of an incoming phone call.

In some embodiments, a global position system (GPS) sensor **540** in the programmable communications device **510** can be used to provide geographical location information. In some embodiments, this geographical location information can be communicated from the programmable communications device **510** to the digital camera **10**, and stored as metadata in association with captured digital images, as was described earlier in relation to FIG. **1**. GPS sensors **540** are well-known in the art and operate by sensing signals emitted from GPS satellites. GPS sensors **540** receive highly accurate time signals transmitted from GPS satellites. The precise geographical location of the GPS sensor **540** can be determined by analyzing time differences between the signals received from a plurality of GPS satellites positioned at known locations.

It will be understood that the programmable communications device **510** can be connected to a battery charger (not shown) which can be used to provide power to a set of rechargeable batteries (not shown) in the programmable communications device **510**.

The programmable communications device **510** includes a wireless local area network (LAN) modem **550**, such as a WiFi modem, which communicates to other wireless devices, such as digital camera **10** (FIG. **1**), over wireless communication link **52**. The wireless LAN modem **550** can use various wireless interface protocols, such as the well-known 802.11 wireless interface or the well-known Bluetooth wireless interface. The programmable communications device **510** also includes a wide-area wireless communication system, such as a cellular modem **560** for communicating over a cellular communication link **562**. The cellular modem **560** can use various well-known cellular communications protocols, such as the 3G or 4G protocols.

It will be understood that the processor **520** in the programmable communications device **510** serves as a data processing system which can be controlled by an executable software application, such as an APP, stored in firmware memory **528**. The executable software application can include instructions for causing the data processing system to implement the method for processing captured digital images described earlier with reference to FIG. **2**. The executable software application can also include instructions for causing the data processing system to implement the method described in reference to FIG. **7**.

FIG. **7** is a flowchart of a method for controlling a programmable communications device **510** (FIG. **6**) to transmit digital images to sharing destinations **250** in accordance with the method described earlier with references to FIG. **3** and FIG. **4**. In some embodiments, the method is provided using an executable software application which is stored in the firmware memory **528** of the programmable communications device **510** when the device is purchased. In other embodiments, the executable software application is provided by a service provider, using for example an "APP store", and transferred from a network server associated with the service provider to the programmable communications device **510** using the cellular modem **560** or the wireless LAN modem **550** and then stored in the firmware memory **528**.

In designate digital camera step **600**, the processor **520** in the programmable communications device **510** designates a digital camera **605** from which digital images will be received. In some embodiments, this step is done by initiating a pairing operation during which the programmable communications device **510** detects any digital imaging devices in the vicinity that are capable of sharing digital images. In some embodiments, both the programmable communications device **510** and the digital camera **605** must be simultaneously placed into a pairing mode. In some embodiments, the pairing operation can be initiated from either the programmable communications device **510** or the digital camera **605**. In some embodiments, the pairing operation can occur automatically if the programmable communications device **510** detects only one device in the vicinity capable of sharing digital images. In a preferred embodiment, the designate digital camera step **600** only needs to be performed once, and then the programmable communications device **510** can be utilized for repeated sharing operations.

In receive digital images and sharing data step **610**, the programmable communications device **510** receives one or more digital images **615** and associated sharing data **620** indicating one or more sharing destinations that the user of the digital camera **605** has designated for the digital images **615**. In a preferred embodiment, the digital images **615** and sharing data **620** are received from the digital camera **605** using the wireless LAN modem **550** (FIG. **6**) via the wireless communication link **52** (FIG. **6**). The digital images **615** may be either digital still images or digital video images or both.

In a transmit digital images to sharing destinations step **625**, the programmable communications device **510** transmits the one or more received digital images **615** to the one or more sharing destinations specified by the sharing data **620**. In a preferred embodiment, the digital images **615** are transmitted using a wide-area wireless communication system, such as over the cellular communication link **562** using the cellular modem **560**.

In some embodiments, the digital images **615** that are received in receive digital images and sharing data step **610** are conditioned in a manner appropriate for a particular sharing destination. This conditioning can include, for example, resizing the digital image, modifying a compression type, modifying a compression level or encoding the digital image using a different file format. For example, the processor **520** may resize the received digital images **615** in order to create a reduced resolution images (i.e., having a smaller number of pixels) for a first sharing destination, such as a Facebook account while maintaining full resolution images to be shared with a second sharing destination, such as a Kodak Gallery account. The processor **520** then transmits the full resolution

images to the Kodak Gallery account, and the reduced pixel resolution images to the Facebook account. In some embodiments, information specifying how to condition the digital images for particular sharing destinations is provided in the sharing data **620** received in receive digital images and sharing data step **610**. In other embodiments, information specifying how to condition the digital images **615** for particular sharing destinations is provided as part of the "APP", and is stored in firmware memory **528**. In some embodiments, the conditioning of the digital images can also include adjusting other image attributes such as sharpness or tone scale and color reproduction attributes according to preferences that can be defined in association with different sharing destinations. For example, if one of the sharing destinations is an E-mail account associated with a particular user, then all images sent to that user can be conditioned according to user-defined preferences for that user.

In some embodiments, a protocol or codec transformation is performed by the processor **520** in the programmable communications device **510**, in order to transmit digital video images in a more efficient manner. For example, the processor **520** may reformat the received digital video, in order to create a video that is smaller in size. For example, if the received digital video image uses a Motion JPEG image compression, the digital video may be reformatted using an H.264 image compression. Many Internet sites have video size limits and using a better compression algorithm allows a user to send lengthier video while staying under the upload size limitation. In some embodiments, the information on the video size limit for the sharing destinations is provided in the sharing data **620**. In other embodiments, the information on the video size limit for the sharing destinations is provided as part of the "APP", and is stored in firmware memory **528**.

Some embodiments may, in response to the network path priority **335** (FIG. **4**) or other metric, automatically, or in response to user command, perform a share to a given sharing destination **315** (FIG. **4**) in two parts. If the metric for sharing is currently above some threshold, the digital camera **10**A may apply a transformation to the image to lower the cost of the share. For example, rather than transmit an entire digital video, the digital camera **10**A may transmit instead a digital still image representing the digital video, or a condensed digital video constructed by applying any of the various video summarization algorithms known in the art. For a digital still image, the digital camera **10**A may down-sample the digital image to a degree beyond any down-sampling that would normally be associated with the sharing destination **315**. At a subsequent time, when the cost of transmission has gone below some threshold, the sharing process can be completed in its original intent to the sharing destination **315**. This behavior of sending a summary representation may be carried out automatically by the digital camera **10**A in response to a user preference setting. Alternatively, the digital camera **10**A may prompt the user before sending a summary representation. The digital camera **10**A may give the user the choice of sending only a summary representation, sending a summary representation now with the normal shared representation deferred, or deferring the entire share operation until such a time as the cost of transmission goes below the threshold.

FIG. **8** is a diagram illustrating more details of a particular embodiment of a method for sharing digital images **615** (FIG. **7**) from digital camera **10**A to sharing destinations specified by associated sharing data **620** (FIG. **7**) via a network pathway using a particular smart phone **220**A (as in FIG. **3**). It will be obvious to one skilled in the art that similar process can be applied for the other devices shown in FIG. **3**.

In some embodiments, in order to facilitate pairing, the digital camera **10**A maintains a list of nodes that are authorized to communicate with the digital camera **10**A. For each authorized node, the digital camera **10**A stores relevant information pertaining to the node. In a preferred embodiment, the node information includes a GUID (globally unique ID), as well as a friendly name (e.g., a nickname) for the node, a hashed representation of the authorization token assigned to that node, and the type of pairing. In some embodiments, for each node that is authorized for permanent pairing the digital camera **10**A stores the node information in the firmware memory **28** (FIG. **1**). Information pertaining to nodes that are granted guest/one-time access can be erased after the current wireless session and does not need to be stored in the firmware memory **28**.

In some embodiments, smart phone **220**A, on its first contact with the digital camera **10**A, requests authorization to pair with the digital camera **10**A, communicating with the digital camera **10**A using HTTPS. The digital camera **10**A and smart phone **220**A are not required to authenticate each other as part of this exchange, however. In particular, the digital camera **10**A is not required to provide authorization to the smart phone **220**A.

In some embodiments, the digital camera **10**A, upon receipt of a request from an unknown smart phone **220**A, asks the user of the digital camera **10**A to authorize a connection to the smart phone **220**A. The user interface elements displayed on the image display **32** (FIG. **1**) of the digital camera **10**A can enable the user to choose between different options, such as (i) allowing the smart phone **220**A to pair with the digital camera **10**A, (ii) allowing only a temporary connection between the smart phone **220**A and the digital camera **10**A for the purpose of receiving and sharing one set of digital image, and (iii) rejecting the connection between the smart phone **220**A and the digital camera **10**A. If the user chooses (iii) to reject the connection, then the digital camera **10**A sends a message to the smart phone **220**A with an appropriate rejection status code. If the user chooses (i) or (ii) to accept the connection, then the digital camera **10**A generates a 128-bit authorization token and sends it to the smart phone **220**A in a reply message together with an indication of whether or not the smart phone **220**A is permanently paired or simply authorized for a one-time connection. The digital camera **10**A also adds this node to the list of authorized nodes. If the user chooses (i) to accept the connection as a permanent pairing, then the digital camera **10** also stores this node information in the firmware memory **28**.

In the illustrated embodiment, the smart phone **220**A sends a manifest request to the digital camera **10**A using HTTPS. This request includes the authorization token that it received from the digital camera **10**A. The digital camera **10**A then receives the manifest request, and verifies that the included authorization token matches the expected token by comparing the hashed representation of the token in the request with the stored representation. If they do not match, the digital camera **10**A transmits an authorization error to the smart phone **220**A, and optionally indicates this to the user on the image display **32** (FIG. **1**) of the digital camera **10**A. If the authorization token matches, the digital camera **10**A then generates the manifest, including the credentials in the XML by base64 encoding them, and transmits the manifest to the smart phone **220**A using HTTPS.

The smart phone **220**A then extracts the credentials from the manifest, decoding them using the base64 decoding. The smart phone **220**A then requests the first digital image asset to be shared with a sharing destination, and the digital camera **10**A responds by sending the first digital image asset to the

smart phone **220**A. This continues until all of the digital image assets that are to be shared have been transferred from the digital camera **10**A to the smart phone **220**A. In some embodiments, the sharing data associated with each digital image asset can be sent to the smart phone **220**A together with the digital image asset. In other embodiments the sharing data can be sent as part of the earlier transmitted manifest. In some embodiments, the sharing data is provided using an "Auto Transfer" file as defined in the well-known DPOF 1.1 standard.

Once the digital image assets have been received by the smart phone **220**A, the application software in the smart phone **220**A will proceed to transmit the digital images to the sharing destinations specified by the associated sharing data. For example, the smart phone **220**A can open a cellular communication link **562** to the Internet using cellular modem **560**, and can then transmit the digital images to the respective sharing destinations. It may also use an available Wi-Fi network that has Internet connectivity.

The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

PARTS LIST

2 flash
4 lens
6 adjustable aperture and adjustable shutter
8 zoom and focus motor drives
10 digital camera
10A digital camera
10B digital camera
12 timing generator
14 image sensor
16 ASP and A/D Converter
18 buffer memory
20 processor
22 audio codec
24 microphone
26 speaker
28 firmware memory
30 image memory
32 image display
34 user controls
36 display memory
38 wired interface
40 computer
40A wireless-accessible computer
44 video interface
46 video display
48 interface/recharger
50 wireless modem
52 wireless communication link
58 wireless network
70 Internet
90 white balance setting
95 white balance step
100 color sensor data
105 noise reduction step
110 noise reduction setting
115 demosaicing step
120 resolution mode setting
125 color correction step
130 color reproduction setting
135 tone scale correction step
140 contrast setting
145 image sharpening step
150 sharpening setting
155 image compression step
160 compression setting
165 file formatting step
170 metadata
175 mode settings
180 digital image file
185 camera settings
200 digital imaging system
210 wireless network pathways
220A smart phone
220B smart phone
230 wireless router
240 wireless hotspot
250 sharing destinations
252 social networking site
254 E-mail address
256 image sharing site
258 image storage device
270 tablet computer
300 capture digital image step
305 digital image
310 select sharing destination step
315 sharing destination
320 identify network pathways step
325 network pathways
330 determine network pathway priorities step
335 network pathway priorities
340 select network pathway step
345 selected network pathway
350 transmit digital image step
400 network pathway table
410 home PC network pathway
412 wireless router network pathway
414A hotspot #1 network pathway
414B hotspot #2 network pathway
416 smart phone network pathway
418 tablet network pathway
504 lens
506 digital camera module
510 programmable communications device
512 timing generator
514 image sensor
516 ASP and A/D Converter
518 buffer memory
520 processor
522 audio codec
524 microphone
526 speaker
528 firmware memory
530 image memory
532 image display
534 user controls
536 display memory
540 GPS sensor
550 wireless LAN modem
560 cellular modem
562 cellular communication link
600 designate digital camera step
605 digital camera
610 receive digital images and sharing data step
615 digital images
620 sharing data
625 transmit digital images to sharing destinations step

The invention claimed is:

1. An image capture device comprising:

a processing system configured to:

capture a digital image of a scene;

receive a selection of a sharing destination;

identify a plurality of network pathways for communication with the sharing destination, wherein the plurality of network pathways include intermediate nodes for archiving and relaying the digital image;

determine a priority for each of the network pathways based at least in part on processing capabilities of the intermediate nodes;

determine that a constraint specifying a data transmission cost limit or a priority limit is associated with a recipient at the sharing destination;

defer the transmission of the digital image for a period of time based on the determination that none of the network pathways satisfy the constraint;

after the period of time, select a highest priority network pathway that satisfies the constraint; and

transmit the digital image to the sharing destination using the highest priority network pathway.

2. The image capture device of claim 1, wherein the highest priority network pathway uses near field communication.

3. The image capture device of claim 1, wherein an authorization process is required to connect to the highest priority network pathway.

4. The image capture device of claim 1, wherein the priority is determined responsive to estimated data transfer rates or estimated transmission times associated with the identified network pathways.

5. The image capture device of claim 1, wherein the priority is determined responsive to estimated data transmission costs associated with the identified network pathways.

6. The image capture device of claim 1, wherein the priority is determined responsive to an estimated power usage associated with the identified network pathways.

7. The image capture device of claim 1, wherein the processing system is further configured to:

receive a selection of a plurality of sharing destinations;

determine that a different constraint specifying a data transmission cost limit or a priority limit is associated with each respective sharing destination of the plurality of sharing destinations, wherein each different constraint imposes a different data transmission cost limit or a different priority limit on a respective sharing destination; and

defer the transmission of the digital image to each respective sharing destination in accordance with the respective constraint associated with each respective sharing destination.

8. The image capture device of claim 1, wherein the processing system is further configured to:

transmit a summary representation of the digital image to the sharing destination in a first part based at least on the determined constraint; and

transmit the digital image to the sharing destination in a second part based at least on the determined constraint, the transmission of the second part being deferred until such a time that a network pathway is identified that satisfies the constraint.

9. The image capture device of claim 1, wherein the priority is determined responsive to user-specified preferences.

10. The image capture device of claim 1, wherein the digital image is transmitted to an intermediate node on the network pathway, and wherein the intermediate node transmits the digital image to a plurality of sharing destinations.

11. The image capture device of claim 10, wherein the digital image is transmitted to the intermediate node by a local-area wireless communication system, and wherein the intermediate node is configured to transmit the digital image to the plurality of shared destinations by a wide-area wireless communication system.

12. The image capture device of claim 10, wherein the intermediate node is configured to designate the image capture device as a device from which digital images will be received.

13. The image capture device of claim 10, wherein the intermediate node is configured to transmit a modified digital image to a first shared destination, wherein the modified digital image is modified based on at least requirements of the shared destination, and wherein the requirements are based at least on one of a size, compression type, compression level, or encoding type of the digital image.

14. The image capture device of claim 1, wherein the processing system is further configured to: delay the transmission of the digital image based at least on no network pathways being available.

15. The image capture device of claim 1, wherein the sharing destination is automatically determined based on analyzing the digital image using a person recognition process.

16. The image capture device of claim 1, wherein the processing system is further configured to:

maintain a list of nodes that are authorized to communicate with the image capture device;

store information associated with each of the nodes, wherein the information comprises an authorization token assigned to each of the nodes;

identify the plurality of network pathways between the image capture device and the nodes; and

authenticate the highest priority network pathway with the authorization token.

17. A method comprising:

capturing, by a processing system, a digital image of a scene;

receiving, by the processing system, a selection of a sharing destination;

identifying, by the processing system, a plurality of network pathways for communication with the sharing destination, wherein the plurality of network pathways include intermediate nodes for archiving and relaying the digital image;

determining, by the processing system, a priority for each of the network pathways based at least in part on processing capacities of the intermediate nodes;

determining, by the processing system, that a constraint specifying a data transmission cost limit or a priority limit is associated with a recipient at the sharing destination;

deferring, by the processing system, the transmission of the digital image for a period of time based on the determination that none of the network pathways satisfy the constraint;

after the period of time, selecting, by the processing system, a highest priority network pathway that satisfies the constraint; and

transmitting, by the processing system, the digital image to the sharing destination using the highest priority network pathway.

18. The method of claim 17, wherein the priority is determined based on estimated data transfer rates or estimated transmission times associated with the identified network pathways.

19. The method of claim 17, wherein the determining that a constraint specifying a data transmission cost limit or a priority limit is associated with a recipient at the sharing destination comprises prioritizing a predetermined sharing destination over other sharing destinations.

20. The method of claim 17, wherein the determining that a constraint specifying a data transmission cost limit or a priority limit is associated with a recipient at the sharing destination comprises determining whether to ignore the data transmission cost limit or the priority limit based on the recipient or the sharing destination.

21. A non-transitory computer readable medium having instructions stored thereon, the instructions comprising:

instructions to capture a digital image of a scene;

instructions to receive a selection of a sharing destination;

instructions to identify a plurality of network pathways for communication with the sharing destination, wherein the plurality of network pathways include intermediate nodes for archiving and relaying the digital image;

instructions to determine a priority for each of the network pathways based at least in part on processing capacities of intermediate nodes;

instructions to determine that a constraint specifying a data transmission cost limit or a priority limit is associated with a recipient at the sharing destination;

instructions to defer the transmission of the digital image for a period of time based on the determination that none of the network pathways satisfy the constraint;

instructions to, after the period of time, select a highest priority network pathway that satisfies the constraint; and

instructions to transmit the digital image to the sharing destination using the highest priority network pathway.

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